LIMITED-TERM LIQUID INDUSTRIAL WASTE SOLIDIFICATION FACILITIES

ENVIRONMENTAL ASSESSMENT REPORT

VOLUME I

JANUARY 1980

Ontario

Ministry of the Environment

The Honourable
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Minister

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LIMITED-TERM
LIQUID INDUSTRIAL WASTE
SOLIDIFICATION FACILITIES

ENVIRONMENTAL ASSESSMENT
REPORT

VOLUME I

ONTARIO MINISTRY OF THE ENVIRONMENT

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VOLUME ONE

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1. SUMMARY

This volume together with its companion Volume II, comprises the environmental assessment document of a proposal to construct limited-term liquid industrial waste solidification facilities. The Ontario Ministry of the Environment is a co-proponent with two private waste management companies; the responsibilities of each co-proponent in meeting the requirements of The Environmental Assessment Act are set out in table 2.1. The Ministry is presented as the proponent of the general undertaking, i.e. to employ solidification as the strategy to meet Ontario's liquid industrial waste disposal needs in the limited term and to select those private sector proposals considered most suitable for implementing that strategy. The private waste management companies are the proponents of the specific undertakings, i.e. to construct waste solidification facilities using a specific solidification process at a particular site.

On average, some 270,000 m^3 of liquid industrial wastes are currently being generated each year in Ontario; approximately one half of these wastes are inorganic. It is expected that the amount of these wastes generated will increase at a rate between 3.8% and 4.8% per annum, reaching a level of approximately 340,000 m^3 annually by 1985.

A substantial portion of the Province's organic liquid industrial wastes are incinerated at Tricil's Corunna facility. The balance of these organic wastes are either landfilled or exported to the United States.

The majority of inorganic liquid industrial wastes generated in Ontario are currently being landfilled in approximately twenty sites, most of which are not properly engineered to accept these wastes. The Minister of the Environment has announced his intention to ban the landfilling of untreated liquid industrial wastes as soon as alternate disposal options are available. Approximately 23,000 m^3 of inorganic liquid industrial wastes were solidified at a facility in Hamilton last year. It is not known whether this facility will continue to operate after its current approval expires in June, 1980.

Another 23,000 m^3 of liquid industrial wastes are exported annually to U.S. facilities in New York, Ohio and Michigan. Only a very small amount of wastes is imported into Ontario from the U.S. Restrictions on trans-boundary movement of these wastes ~~could~~ would eliminate or reduce this disposal option at any time. A similar volume of oily waters is used for dust control purposes. Table 3.1 summarizes the method of treatment and disposal of liquid industrial wastes in Ontario.

Deep-welling of liquid industrial wastes was phased out at the end of 1976. Despite favourable technical reviews, proposals to establish disposal wells in deeper, more suitable formations were not successful. Other proposals put forward between 1976 and 1979 to construct waste treatment facilities were either withdrawn or not approved, resulting in the situation where, on an annual basis, over 90,000 m^3 of inorganic liquid industrial wastes are currently being

disposed of in unsuitable landfill sites. Over the period to 1985, it is estimated that more that 900,000 m^3 of inorganic liquid industrial wastes will be generated in Ontario. Unless alternate facilities are provided, some 680,000 m^3 of these wastes will have to be landfilled over the next five years.

There are five general technologies for the treatment and disposal of inorganic liquid industrial wastes most prevalent in North America and Europe today. In addition to these, the no-change option, the option to store liquid wastes and the re-use, recycling and recovery option, were considered as possible alternatives for handling Ontario's inorganic liquid industrial wastes in the interim term. Thus the list of alternatives considered is as follows:

1. No change;
2. Disposal in landfills;
3. Deep-well disposal;
4. Incineration;
5. Physical-chemical treatment;
6. Solidification
7. Interim storage;
8. Re-use, recycling and recovery.

The no change option implies the continuation of present landfilling practices at unsuitable sites to dispose of the majority of the province's inorganic liquid industrial wastes, some 680,000 m^3 in the period to 1985.

There are three alternative techniques which can be used to landfill liquid industrial wastes: direct landfilling, co-disposal, and secure landfilling. In direct landfilling, liquid wastes are deposited directly into open pits. In co-disposal, municipal solid wastes and liquid industrial wastes are deposited together in the landfill. This method is preferable to direct landfilling because the solid wastes have the capability of soaking up the liquid wastes, thereby slowing down the release of contaminants to the environment and allowing greater opportunity for adsorption of contaminants by soils (attenutation). Secure landfilling is a total containment or vault technique which isolates the waste from the immediate environment by the use of engineered systems, including liners, collection tiles, and leachate recirculation. This technique is normally employed for sludges, solids, and other wastes difficult to treat for technical or economic reasons.

Deep-well disposal consists of the injection of liquid industrial wastes into porous geological formations. In most cases some form of pre-treatment of the wastes is required to ensure compatibility of the wastes with the receiving formation which results in a solid or semi-solid residue which must be disposed of in addition to the liquid being deep-welled. Disposal into the relatively shallow Detroit River Formation near Sarnia was phased out after 1974 but disposal into the deeper formations available in the province is still permitted.

Incineration is a commonly used technique for the disposal of organic wastes, but can also be used to treat inorganic liquid industrial wastes if sufficient organic content or fuel is available to provide the necessary heat. This process leaves a solid, inorganic waste residue or ash which requires careful disposal, preferably in a secure landfill.

A variety of physical and chemical processes may be combined to treat the majority of inorganic liquid wastes commonly encountered in industry. Difficulties with this option include the cost of chemicals for some processes, and the necessity to dispose of solid residues as well as effluent "brines" which normally contain 1 or 2 percent dissolved solids.

In solidification or chemical fixation, a thickener or binding agent is added to the wastes, or chemical reactions are induced, to form a single sludge or solid, rather than separating out the solid and liquid components of the waste into two or more secondary waste streams. The major difficulty with this technology is that only limited information about the long-term stability of the solid product and about leachate characteristics is available. Until more is known about the nature of leachates generated by the solidified waste material, and about the long-term stability of this material, disposal or storage will need to be limited to landfill sites carefully engineered to permit leachate collection, site monitoring and surface drainage control.

Considering the interim storage option, some kind of central storage facility must be envisaged since most industries do not have the capacity to store wastes for extended periods. Storage in bulk tanks or in steel or plastic drums was investigated. Major disadvantages found were high costs and the added risk due to double handling of all wastes.

Investigation of the re-use, recycling and recovery option established that only very small amounts of inorganic liquid industrial wastes are being handled in this manner at present (less than 0.2% of the total) in the province, and that the potential for increasing these amounts was not likely to provide any significant relief for Ontario's liquid industrial waste disposal problem. This option was not given further consideration.

The remaining seven alternatives described above were evaluated on the basis of the following criteria:*

1. Time required from approval to commissioning of a facility;
2. Siting requirements, taking into account site location, land requirements, and the number of sites required;
3. Consistency with Ontario Government policy on the disposal of liquid industrial wastes;
4. Engineering considerations, including the reliability of the technology, the flexibility of the technology to handle different kinds of wastes, and the nature of any secondary waste streams which result.
5. Projected cost to the user.

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* It must be emphasized that the order in which criteria are presented throughout the report does not necessarily reflect their order of importance.

Table 5.1 presents a summary of the comparative assessment of the options on the basis of these criteria, and table 5.2 indicates which alternatives were given preferred status under each criterion. From table 5.2, it can be seen that the interim storage option (#7) was a close second to the solidification option (#6). Option 7 was rejected, however, due to the significantly higher costs involved. On the basis of this assessment, it was decided to proceed with a strategy to provide limited-term, inorganic liquid industrial waste solidification facilities.

A review of lands available to the Government suggested that none were suitable for a solidification facility, for one or more reasons. Either they were not situated near the major centres of waste generation, or they were associated with recreational or institutional facilities, or they were located in environmentally sensitive areas. It was therefore decided to call for proposals from the private sector. The government offered certain incentives to industry to encourage response and to offset the disadvantages inherent in a limited-term project.

Seven companies responded to the call for proposals:

1. Browning Ferris Industries;
2. Canadian Waste Technology Inc.;
3. Frontenac Chemical Waste Services, Ltd.;
4. I.U. Conversions;
5. MBL International Contractors Inc.;
6. Stablex (Canada) Ltd.;
7. Woodington Systems Inc.

An unsolicited proposal subsequently received from Tricil Waste Management Ltd. using a different technology was considered by the Minister to have sufficient merit, that he directed it be evaluated along with the other proposals.

Two of the proposals were eliminated at the initial screening stage. The I.U. Conversions proposal was rejected because the company did not specify a site, and the MBL International Contractors proposal was rejected because it did not involve a recognized solidification process and because it involved significant costs to the Government.

The remaining six proposals were evaluated taking into consideration:

i) The amount of time required to commission the facility subsequent to approval;

ii) Projected cost to the user as stated in the proposal;

iii) Potential cost to the government;

iv) Site suitability; and

v) Engineering and technical consideration.

Table 5.3 summarizes the comparative assessment of the proposals
on the basis of these criteria.

In this manner Browning Ferris Industries and Woodington Systems Inc. were selected as the companies with the preferred proposals. The Ministry has undertaken to operate an independent product and site evaluation program to accompany each of these projects in order to monitor the

long-term stability of the solid product and the extent of leachate production. Details of this evaluation program will be provided when available as an addendum to this report. Should environmental contamination problems develop at either site which cannot be mitigated by other means, the Ministry will relocate all solid product to a secure landfill site, which is the key component of the long-term waste management plan currently being developed by James F. MacLaren, Consulting Engineers.

2. INTRODUCTION

2.1 Purpose

The Minister of the Environment has determined that there is a need to provide limited-term facilities for the the management of Ontario's inorganic liquid industrial wastes. Together with two private waste management companies, the Ministry of the Environment proposes to construct two liquid waste solidification facilities to meet this need. The purpose of this report, consisting of two volumes, of which this is Volume I, is to meet the requirements of The Environmental Assessment Act, section 5 (3), which requires the proponent of an undertaking to submit to the Minister of the Environment:

a) a description of the purpose of the undertaking

b) a statement of the rationale for the undertaking and possible alternatives;

c) a description of the environment that will be affected, what those effects are likely to be, and the necessary mitigating actions; and

d) an evaluation of the alternatives.

Two proposed undertakings are being put forward, one at the Walker Brothers Quarry Site in the City of Niagara Falls, the other at the Ridge landfill site near the Village of Blenheim, Harwich Township. In each case, the Ministry of the Environment, Waste Management Branch is a co-proponent with a private waste management company. In effect, the Ministry takes responsibility as the proponent for the general undertaking, to construct and operate two, limited-term (up to five years) liquid waste solidification facilities to meet the needs of the Province of Ontario, until a long-term plan

for liquid industrial waste management can be developed, approved, and implemented. As such, the Ministry must present the rationale for the general undertaking and a description of the alternatives to solidification or chemical fixation as a strategy to solve the inorganic liquid industrial waste disposal problem in the limited term. At the request of the Ministry, eight companies submitted proposals to construct and operate liquid waste management facilities to implement the Ministry's strategy. It is therefore also the Ministry's responsibility to describe the process whereby two of these proposals were selected.

The two proposals selected were those presented by Browning-Ferris Industries Ltd. (Ridge landfill site) and Woodington Systems Inc. (Walker Brothers Quarry site). These companies may therefore be considered as the proponents of the specific undertaking, to construct and operate a liquid waste solidification facility, using a particular process at a specific site. It is therefore the responsibility of each company to describe the proposed process, facility construction, operation and abandonment, related social and environmental effects, mitigating measures to minimize negative impacts, and involvement of the individuals and communities in the vicinity of their site.

The fulfillment of the responsibilities of the two co-proponents is documented in the two volumes of this report. Volume I, prepared by the Ministry of the Environment, Waste Management Branch, documents the role of the Ministry.

Chapter 3 describes the problem with current methods of liquid industrial waste disposal in Ontario, and the background of how the problem developed. This constitutes the rationale for the general undertaking. Chapter 4 presents a description of the various strategy alternatives considered as possible means of solving this problem, including the option of doing nothing. Chapter 5, goes on to present the evaluation of these alternatives and the selection of the proposals for the specific undertakings. Volume II, prepared by the company for each proposal respectively, presents the detailed proposal description and related environmental effects. For easy reference, Table 2.1 sets out the responsibility of the proponents and the location of the documentation in the report.

2.2 Definitions and Terminology

To facilitate a complete understanding of the proposals being put forward and the analyses herein described some definitions and explanations of terminology follow:

a) "Hauled liquid Industrial Wastes" means those wastes generated by manufacturing or processing operations which are hauled away from the place where they are generated to another location, either off-site or on-site, for treatment and/or disposal.

b) "Liquid" means that the waste is in the liquid or fluid state under normal conditions and can be pumped and must be contained in a suitable vessel. Under this definition,

TABLE 2.1 Proponent Responsibilities and Location of Documentation

Undertaking	Proponent	Responsibilities	Location
General	Ontario Ministry of the Environment, Waste Management Branch	1. To document the need for limited-term inorganic liquid waste management facilities. 2. To present alternative ways of meeting the identified need. 3. To evaluate the alternatives and select a strategy for proceeding to meet the identified need. 4. To select proposals from private companies to implement the proposed strategy.	Volume I
Specific	Browning-Ferris Industries Ltd. OR Woodington Systems Inc.	1. To describe the specific process, the facility being proposed at each site, and the site. 2. To describe the environment that may be affected, possible effects, and mitigating measures. 3. To outline public involvement with the project development.	Volume II

liquid also includes sludges or mixtures of liquids and solids which will flow under normal conditions and which can be pumped through standard pumping equipment or vacuum equipment.

c) "Organic" generally means wastes resulting from the manufacturing or processing operations involving animals or parts of animals, plants, vegetables or fruits, petroleum, coal, and natural gas. In a technical sense, the term organic is used to define those chemicals which are based on the carbon atom. Organic wastes may be fairly easily distinguished by the fact that they can, for the most part, be treated rather simply by high temperature incineration. Thus a rather simple definition of organic when dealing with wastes would be to classify organic wastes as those which can be destroyed by incineration.

d) "Inorganic": Accepting the definition of organic wastes above, then inorganic means all the other wastes which are part of the disposal problem in Ontario. There is a grey area where mixtures of the two general classes of substances occur. For example, oil/water mixtures comprising mainly oil contaminated with a small amount of water, would be classed as organic. Conversely oily water, which comprises mainly water contaminated with a small amount of oil, would be classed as inorganic if it does not lend itself readily to incineration.

e) "Exemptions": It is necessary, to understand that certain types of materials which are commonly accepted as

wastes are exempted from inclusion in the way-bill system and therefore do not appear in the data presented. These are wastes which are generally reclaimed, recovered, or reused and therefore do not contribute to part of the disposal problem.

f) "Waste Oils": The majority of waste oils in Ontario are collected and used either for road oiling, re-refining, or as fuel in cement-making operations. Those waste oils which are not used for any of these operations and require disposal are reported through the way-bill system and contribute to the organic fraction of the total wastes.

g) "Solvents": There exists in Ontario a fairly extensive solvent reclamation and recovery operation and the bulk of the waste solvents generated do not appear as part of the waste disposal problem. Examples of major solvent reclaiming operations are: Anachemia Chemicals Limited, Mississauga; Varnicolour Limited, Elmira; and A & J Chemicals, Thornhill. In addition, there are numerous small waste solvent reclaiming operations.

CHAPTER 3 STATEMENT OF NEED

Section 5 of The Environmental Assessment Act, 1975 requires the proponent to describe and state the rationale for the project. As noted in the introduction to this report, the decision to proceed with solidification as the interim method for handling liquid industrial wastes was taken by the Ministry of the Environment, and it is therefore incumbent upon the Ministry to present its rationale. Simply stated the rationale for this proposal consists of the need to provide for an acceptable method of treating and disposing of inorganic liquid industrial wastes. This chapter will present the specifics of the problem, the pertinent background and a description of the present situation in order to demonstrate this rationale.

3.1 The Problem

Appendix I-A shows data for the eight month period February to September, 1979 indicating the various classifications of liquid industrial wastes that are generated and disposed of in Ontario. The Ministry's "Classification Guideline of Hauled Liquid Industrial Wastes, 1978" (Appendix I-B) shows more precisely the nature of the wastes which make up each classification. It may be seen from these data, that the majority of liquid industrial wastes consist of oily waters, waste oils and organic solvents, acids, alkalis and metal finishing wastes, pigments, paints, printing and adhesive wastes, plant and animal wastes, inert sludges and other non-classified organics and inorganics. In general,

the 200 series classifications and the 401 classification constitute the organic wastes, the remainder being considered inorganic. For treatment purposes, however, some of the 201 classification, "oily water", may require treatment as an inorganic if the concentration of oil in water is sufficiently low. Wastes are generated at the rate of approximately 23,000 m^3 (5 million imperial gallons) per month, or 270,000 m^3 (60 million gallons) annually. On the average, slightly more than half of these wastes are inorganic liquid wastes. Figure 1 illustrates the types and origins of these wastes for February 1979.

The data presented in Appendix I-A were collected from the Ministry of the Environment's Transfer of Liquid Industrial Waste forms (Appendix I-C), completed by producers, receivers and carriers of liquid industrial waste as required by Ontario Regulation 926/76. This new way-bill form, which incorporates the waste classification coding system, was introduced in January 1979 and has enabled the Ministry to assemble more precise data on the quantities and characteristics of liquid industrial wastes being generated and disposed of in Ontario. The way-bill system was first established in April 1977. At that time 35 million gallons of liquid industrial wastes were reportedly hauled each year. The increase to 60 million gallons per annum by 1979 undoubtedly reflects an improvement in the data as more complete reporting took effect. Nevertheless, it is expected that the amount of liquid industrial wastes generated will

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LIQUID WASTE DISPOSAL STUDY

liquid waste volumes – february 1979

INORGANIC

ORGANIC

UNCLASSIFIED

VOLUME IN GALLONS

500,000
200,000
100,000
50,000
20,000
10,000
5,000
1,000

SOURCE: Ministry of Environment – Waybill Monitoring System

COMMUNITIES

0 8 16 24 MILES
0 10 20 30 40 KILOMETRES

figure 1

increase at a rate equal to primary and secondary industrial growth in general. The Gross Provincial Product is forecast to grow at an average annual growth rate between 3.8% and 4.8%.[1] If waste generation maintains a similar growth rate, some 340,000 m^3 (75 million gallons) of liquid industrial wastes will be generated annually by 1985.

3.2 Present Methods of Disposal of Liquid Industrial Wastes

Incineration

There are, at present, four methods of disposal of liquid industrial wastes in the province. Tricil Limited operates an incineration complex at Corunna, near Sarnia. This facility handles a substantial portion of organic liquid industrial wastes generated in the province and is now operating at full capacity. The balance of the organic wastes, including chlorinated organics and some heavy sludges and semi-solids which cannot be processed through the Tricil facility are being disposed of in landfill sites or exported to the United States.

Landfilling

In 1979, there were twenty-three landfill sites accepting liquid industrial wastes in Ontario. These are listed in Appendix I-D. Of these, eleven are fully certified,

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1. The Ontario Economic Council, 1977; The Ontario Economy to 1987, p.9, Table 1.

two are restricted to limited types of liquid industrial waste, two are transfer stations only, six are not considered properly certified to receive liquid industrial wastes and two were scheduled to close before the end of 1979. These sites accepted approximately 120,000 m^3 (26 million gallons) of liquid industrial wastes, mostly inorganic, representing some 43% of the liquid industrial wastes generated in the province in 1979. As part of this seven-point program for the disposal of liquid industrial wastes made public in October 1978, the Minister of the Environment announced a prohibition on the landfilling of untreated liquid industrial wastes effective January 1, 1980. Because alternative disposal facilities are not yet available, it has not been possible to implement this ban. In the belief that direct landfilling of untreated liquid industrial wastes is not in the best interest of the people of Ontario, it is still the Minister's intention to implement this ban as soon as alternate treatment and disposal facilities can be developed. The technical merits and difficulties associated with this disposal method will be discussed in Chapter 4.

Solidification

An experimental solidification facility using the Krofchak process and operated by Frontenac Chemical Waste Services Ltd., located at the Upper Ottawa Street landfill site in Hamilton, has been operating since mid-1977. By agreement with the Region of Hamilton/Wentworth, the experimental facility handles all applicable inorganic wastes formerly being landfilled at the site. In 1978 and 1979 this

amounted to about 23,000 m^3 per year. The solidified material is used as cover in the landfilling operation at the same site. The facility has a certificate of approval from the Ministry which is valid until June 1980. Corporate plans for this facility beyond that date are not known at this time.

Export

Operators in Ontario exported approximately 23,000 m^3 (5 million gallons) of liquid industrial wastes to U.S. facilities in 1979. Receivers of these wastes were:

1. Chem-Met Services Ltd., Detroit, Michigan.
2. Frontier Chemicals Ltd., Niagara Falls, N.Y.
3. Newco Chemical Waste Services Ltd., Niagara Falls, N.Y.
4. Ohio Liquid Disposal Inc., Fremont, Ohio.
5. SCA Services, Model City, New York.

The bulk of the transboundary movement of wastes at present is from Ontario to U.S. operators. Tricil Limited accepts a small amount of wastes from U.S. operators at its Corunna incineration facility. It is considered unacceptable to rely too heavily on export as a means of waste disposal, yet the current levels of export (7% to 9% of total wastes) are the highest historically recorded. In addition to its vulnerability to the criticism that Ontario is not able or willing to deal with its own hazardous wastes, such a policy would leave the province with no alternatives should the Canada/U.S. border be closed to the transboundary movement of wastes. While there is no immediate indication of such

restrictions being imposed, it must be recognized that such action is possible at any time. For these reasons, it is considered essential that Ontario pursue a policy of self-sufficiency in the treatment and disposal of liquid industrial wastes.

Ontario Regulation 926/76 also provides for the direct disposal of liquid industrial wastes to a municipal sewage treatment plant, provided an approval has been granted under The Ontario Waste Resources Act, and with approval of the owner of the sewage works. Based on data from the way-bills of liquid industrial wastes being treated and disposed of in this manner is approximately 2000 m^3 per year (less that 1/2 million gallons). Only wastes which are compatible with such a process, and which will not upset the biological processes ongoing in a sewage works, are eligibile for disposal in this manner.

Table 3.1 summarizes the method of treatment and disposal of liquid industrial wastes in Ontario. A fifth method is indicated - dust control. This comprises the spraying of oily waters on landfill sites and gravel roads to mimimize dust levels during summer and fall.

3.3 Historic Background

It is pertinent at this point to summarize briefly the course of events which had led up to the present situation. In the early 1970's when concern was first raised about the manner in which liquid industrial wastes were being handled, landfill, deep-well disposal and incineration were the methods of disposal employed. Comprehensive authority to

TABLE 3.1 TREATMENT & DISPOSAL OF LIQUID INDUSTRIAL WASTES IN ONTARIO

METHOD	CUBIC METRES X 10^3 PER YEAR (Millions of gallons in brackets)						% OF TOTAL
	ORGANIC		INORGANIC		TOTAL		
Incineration	49.6	(10.9)	32.3	(7.1)	81.9	(18.0)	30
Landfill	37.8	(8.3)	81.4	(17.9)	119.2	(26.2)	43
Solidification	8.6	(1.9)	18.7	(4.1)	27.3	(6.0)	10
Export	7.3	(1.6)	16.4	(3.6)	23.7	(5.2)	8.6
Dust Control	4.1	(.9)	17.7	(3.9)	21.8	(4.8)	8.0
Canadian Waste Materials Exchange	0.25	(.05)	0.25	(.05)	0.5	(0.1)	0.2
TOTAL	107.7	(23.7)	166.8	(36.7)	274.4	(60.3)	100

Notes:

Figures may not add due to rounding.

Conversion: 1 cubic metre = 220 imp. gals.

Source: Based on MOE data from Transfer of Liquid Industrial Wastes Way-bill forms for April, 1979 and on Canadian Waste Materials Exchange, "Summary of Activities", December 1979.

licence and approve waste disposal facilities was mandated in 1969, with the proclamation of The Waste Management Act. Appropriate regulations were first made in 1970, and their enforcement is now effected by the Ministry under the authority of The Environmental Protection Act, 1971.

Concerns were first raised by the State of Michigan that the deep-well disposal into the Detroit River Formation by a number of companies operating in Lambton County, Ontario was contaminating Michigan formations. Sub-surface brines being extracted from the same formation in Midland, Michigan for use in Dow Chemical's processing were found to be varying in quality, and it was feared that the disposal operations were affecting these brines. Other claims about wastes and oil or gas suddenly appearing up through abandoned wells as a result of pressuring the formation were also made. Ontario Regulation 152/73 was made prohibiting further deep-welling of industrial wastes into the Detroit River Formation after April 1, 1974. This deadline was extended until December 31, 1974 because alternative disposal methods for inorganic liquid wastes were not available. A further extension was granted to one operator, Tricil, in January 1975, but the allowable volume of waste was reduced to 11,400 m^3 (2.5 million gallons) in the last half of the year. Allowable volumes were further reduced to 13,600 m^3 (3.0 million gallons) per year in January 1976. The Tricil wells operated on this basis until December 31, 1976 when the Ministry refused to grant a further extension of approval to operate.

In the meantime, other efforts to establish a deep well operation for disposal of inorganic liquid industrial wastes were underway. In 1974 the Environmental Hearing Board approved an application by Tricil Ltd. to construct and operate a Cambrian disposal well in Moore Township, Lambton County. The Company decided not to proceed with the project, citing market uncertainties as the reason. A review of the waste disposal problem and technological options was conducted by the Ministry in the fall of 1974 and by the consulting engineering firm of James F. MacLaren in spring of 1975. Both reviews concluded that deep-well disposal into the Cambrian formation was an acceptable option. Subsequently, the Ministry pursued the development of a Cambrian well at a site recommended by the consulting geologists Pounder and Harmon. These plans were shelved at the direction of a newly appointed Minister of the Environment, in the fall of 1975.

A proposal put forward by the Ontario company, Sub-surface Pollution Control in May 1975 to develop a cambrian well in the Township of North Gosfield, Essex County was abandoned by the Company in the face of severe public opposition even before the formal hearing stage was reached. A proposal by Cambrian Disposals Ltd. to construct a cambrian well at Canborough in Haldimand/Norfolk in 1976 suffered the same fate. The only other deep-welling proposal was initiated by Tricil in November 1977 and involved a joint venture with the Ministry to construct a cambrian disposal well at the Tricil property in Moore Township. A draft agreement was negotiated but the Minister shelved the project in the fall of 1978 pending a review of alternatives.

Efforts to solve the liquid industrial waste disposal problem were also underway on other technological fronts during this time. In the period 1970-73, the Government of Ontario purchased a site in Mississauga and contracted with Tricil Waste Management to construct and operate a waste treatment and disposal complex. Phase I, a waste incinerator, was commissioned in 1973. This facility handled about 32,000 m^3 (7 million gallons) per year of mixed liquid industrial wastes. It ceased operation in July 1978 and operations being consolidated at the Corunna site when the Company faced major expenditures to upgrade the facility to meet MOE emission and control requirements. Also about the same time, (1973), a private consortium, Thermal Destruction Systems, constructed an incinerator in the Hamilton area. This represented the third such incinerator operation in the Province, but it was closed down in APRIL 1977 because quantities of organic liquid industrial waste were insufficient to support three incinerators. ≈ cost of $4 410^6 reqd to upgrade.

In the fall of 1976, Nanticoke Waste Management Ltd., a subsidiary of the D & D Group made application for approval of a physical/chemical treatment complex and land-fill site to handle liquid industrial wastes near the Lake Erie Industrial Park at Nanticoke. Hearings on the proposal were held by the Environmental Assessment Board in the summer of 1977. The Board's report, issued in April 1978, recommended the proposal not be approved.

A minor success was the commissioning of the experimental solidification facility in mid-1977 at the Upper Ottawa Street landfill site in Hamilton. As noted earlier, the future of the facility which used the Krofchak process and in 1979 handled approximately 17% of Ontario's inorganic liquid industrial wastes, is uncertain at this time. Originally operated by K.D. Enterprises, the facility is now operated by Frontenac Chemical Waste Services Ltd., another subsidiary of the Laidlaw group of companies. K.D. Enterprises sought approval in mid-1978 to construct a permanent liquid waste solidification plant in Fort Erie. The Company withdrew this application, however, in the face of severe opposition by the Town Council and citizens.

Thus, subsequent to the closure of the Tricil deep-well disposal operation at the end of 1976, failure to gain approval of alternate facilities and withdrawal of proposals by companies resulted in the situation where over 65% of Ontario's inorganic liquid industrial wastes were being directly landfilled at the end of 1977. The problem was severely exacerbated in April 1978 when the Council of Metropolitan Toronto closed the Beare Road landfill site to liquid industrial wastes due to odour and excess leachate problems. This eliminated the major disposal outlet for inorganic liquid industrial wastes in the Toronto area.

The Minister's intention to ban direct landfilling of liquid industrial wastes at all sites was announced in October 1978 as part of his seven-point program. Also

included in this program are the development of treatment and disposal facilities, interim storage to allow time for the development and implementation of a long-term waste management plan, and the development of guidelines and regulations for improved controls.

This proposal is intended to partially meet the need by providing limited-term facilities until such time as permanent facilities can be developed. Since October 1978, the only undertaking other than those being put forward here, is the application by the Region of Durham for approval to convert the Ajax sewage treatment plant into a liquid waste treatment facility to handle approximately 40,000 m^3 (9 million gallons) of inorganic liquid industrial wastes annually. It is expected that this volume of wastes will be available within a 80 km radius of Ajax. Hearings on this application commenced in December 1979.

3.4 Summary of Need Statement

The events as described above have resulted in the situation where on an annual basis, upwards of 91,000 m^3 (20 million gallons) or inorganic liquid wastes are currently being disposed of directly into landfill sites, most of which are not properly engineered or monitored for the handling of these wastes. Some 23,000 m^3 (5 million gallons) annually are presently being treated at the solidification facility in Hamilton, and a further 23,000 m^3 are exported each year.

Over the five year period to 1985, it is estimated that a total of 910,000 m^3 (200 million gallons) of inorganic liquid industrial wastes will be generated in Ontario. Only 230,000 m^3 (50 million gallons) can be handled by existing methods, assuming export levels remain constant and excluding landfilling. In other words, unless alternate facilities are developed for treatment and disposal, 680,000 m^3 (150 million gallons) of these wastes will have to be landfilled in the next five years.

Some of these wastes may be reduced in volume by re-use, recycling and recovery operations. In most instances, re-use options are very limited, and recycling and recovery operations result in secondary waste streams which, while somewhat reduced in volume, are often even more hazardous than the original waste product. These secondary streams must of course also be disposed of. It is the Government's policy to support and encourage the re-use, recycling and recovery options, but to rely on the economic forces prevalent in the marketplace to induce industry to take this course as and when it is advantageous and economically feasible to do so. Some industries have already pursued these conservation options, as evidenced by the re-refining of waste oils as lubricants, the use of waste caustic soda by pulp mills, the recovery of metals from waste-waters of some electro-plating shops, and the use of pickle liquor for phosphorous removal at sewage treatment plants. The Ministry of the Environment has supported the nation-wide Canada Waste Materials Exchange

operated by the Ontario Research Foundation to promote the exchange and recovery of wastes among different manufacturers. This program, operating since 1978, has to date met with only limited success where liquid industrial wastes are concerned, facilitating the recovery or exchange of an estimated 1100 m^3 (0.25 million gallons) nationally since January, 1978.[2]

This Ministry will continue to seek ways to encourage the re-use, recycling and recovery of industrial wastes. It is our belief, however, that the effect of these options will only be felt in the longer term, and that these options will in any event only partially solve the problem of liquid industrial waste disposal. The problem at hand is immediate and large-scale, and requires commensurate measures for its resolution. The following chapters will present in greater detail the alternative measures considered and the selection of the preferred alternative.

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2. Derived from Ontario Research Foundation, December 1979, "Summary of Activities of the Canadian Waste Materials Exchange" January 1978 to December 1, 1979

4. DESCRIPTION OF ALTERNATIVES FOR LIMITED TERM TREATMENT AND DISPOSAL OF LIQUID INDUSTRIAL WASTES

In recent years, Ministry of the Environment staff have acquired considerable knowledge and experience of liquid industrial waste treatment and disposal technologies. Approaches taken in other countries have been studied, and treatment/disposal facilities in Europe and other parts of North America have been visited. As part of the Ministry's program to develop a long-term plan for the province, a detailed study of industrial waste control procedures in North America and certain industrialized countries in Europe is underway. It is intended that the most appropriate technologies and control methods to meet Ontario's specific needs will emerge from this study.

The technologies found to be in widespread use in the North American and European waste treatment and disposal industries tend to be quite similar. Most prevalent are the general technologies which can be applied to broad classes of wastes. For inorganic liquid industrial waste treatment and disposal, these include:

1. Disposal in landfills
2. Deep-well disposal
3. Incineration
4. Physical/chemical treatment
5. Solidification or Chemical fixation

Specific technologies with applications to restricted classes of wastes include the hundreds of patented and proprietary processes for the recovery or destruction of specific

components of a particular type of waste stream. These technologies are less common. Their success depends heavily on the availability of large quantities of a specific type of waste stream, and on the economics of the recovery or destruction operation to the industry of origin or to a secondary market. For these reasons, specific waste management technologies are usually found in on-site treatment situations where large, individual companies can justify their installation on the basis of the value of recouped materials or the saving of waste haulage and disposal fees. The growth of a waste disposal industry in Ontario attests to the fact that such options have only rarely been attractive to industry, and that centralized waste treatment and disposal offers economic advantages. It should also be noted that, from a standpoint of environmental protection, the centralized treatment and disposal of wastes affords greater opportunity for control of the process and effluent disposal. To achieve this added control, there is some increase in the risks associated with waste transportation, however.

The first alternative for dealing with the treatment and storage of Ontario's inorganic liquid industrial wastes in the short term is to accept the status quo and make no changes while the problem receives further study and a long-term plan is developed and approved. The Ministry has estimated the process of developing and receiving approval for a long-term plan will require five years. Therefore, acceptance of the status quo implies a continuation of present

landfilling practices to dispose of the majority of the province's inorganic liquid industrial wastes, some 680,000 m^3 (150 million gallons) in the period to 1985. This option also precludes any benefits which would accrue from field research, insofar as controlled technological applications would be delayed until such time as a long-term waste management plan is adopted and the recommended facilities are constructed. The hazards inherent in the current situation of widely dispersed, poorly controlled landfilling of liquid industrial wastes would continue. Problems which can arise have already been demonstrated at the Beare Road landfill site which accepted five million gallons of liquid industrial wastes annually for six to seven years prior to being closed. This practice was stopped because excessive odours and leachate were being created, apparently as a result of the liquid wastes being deposited. The problem was alleviated when liquid industrial wastes were no longer accepted at the site.

In addition to the five general technology options listed above, two other alternatives received consideration: interim storage, and re-use, recycling and recovery. The remainder of this chapter briefly describes each of these alternatives.

4.1 Disposal in Landfills

There are at present three (3) alternative techniques used for the landfilling of liquid industrial waste: Direct landfilling, co-disposal and secure landfilling.

4.1.1 Direct landfilling is a technique whereby compatible liquid wastes are deposited directly into the site in open pits. This alternative is capable of handling large volumes of waste but is dependent on the hydrogeological setting of the site and, to a limited degree, on the potential for chemical reactions which may occur when various waste types are mixed.

To evaluate the suitability of a particular location for this type of landfill, extensive hydrogeological investigation is required. Specific requirements include loamy soils with high attenuation capacity (some sand and clay content), a low water table or an aquifer of low resource value, and careful surface water management to minimize leachate discharge into the environment.

While it is known that soils have the ability to attenuate some substances, including heavy metals, it is also known that other substances such as chlorides, sulphates and nitrates are not attenuated in this manner. The state-of-the-art for predicting the behavicur of a combination of different substances in a landfill is not yet well defined, although extensive research is continuing. It is often argued that all contaminants deposited in a landfill which are not susceptable to biological degradation or chemical

neutralization will ultimately migrate into the groundwaters. To a great extent the design and utilization of this type of landfill is premised on the rate at which leachate will enter the environment and be assimilated without causing adverse effect on any potential user.

For these reasons, it is widely held that wastes high in liquid content should not be landfilled without prior treatment to transform them into a reasonably stable solid or semi-solid form. The U.S. Environmental Protection Agency Guidelines for Landfilling include this as a requirement, and list the following categories of waste as unacceptable for landfilling:

- materials which readily ignite
- reactive materials
- volatile materials
- incompatible materials
- bulk liquids

Liquid industrial wastes in Ontario are usually collected and transported in bulk, are frequently incompatible and may, on occasion be reactive or volatile.

Even with carefully engineered sites based on detailed hydrogeological investigation prior to use, the possibility of off-site contamination of soils or

groundwaters as a result of landfilling liquid wastes remains very real. Once such contamination occurs, contingency measures can be costly in both human and financial terms. It may be necessary to purchase contaminated areas, relocate people, provide for alternate water supplies, pump out affected aquifers or undertake other engineering works. A further difficulty is that suitable conditions for landfilling operations of this type are most frequently coincident with good agricultural lands.

One of the operational management difficulties of direct landfilling is the potential for fires, explosions and general safety conditions for on-site workers. Also, significant volumes of wastes in open pits are subject to vandalism and present a potential hazard to the public and to animal life.

4.1.2 Co-disposal landfilling is the method whereby municipal solid wastes and liquid industrial wastes are either deposited jointly at the working face of the landfill or the liquids are deposited into an area previously filled with municipal solid wastes. As with direct landfilling, this alternative is capable of handling large volumes of wastes but requires the same diligence in the hydrogeological assessment and the control of contingencies necessary to ensure protection of the surrounding environment.

This method is preferable to direct landfilling because the solid wastes have the ability to absorb or soak up the liquid wastes which slows down the release of contaminants. Also, the method provides a greater amount of time for biological activity and substantially reduces the potential hazards to on-site workers, to the public and to animal life.

In general, the sites in Ontario which currently accept liquid industrial wastes have not been appropriately engineered to meet the requirements of co-disposal. Furthermore, minimal hydrogeological information is available on many of the older sites and, as such, their ability to accept liquid industrial wastes without endangering the environment is in doubt.

Recently, most municipalities have not considered accepting liquid industrial wastes at new landfill sites for fear of adversely prejudicing their chances of gaining approval for disposal of municipal wastes at these sites.

At least four, and possibly as many as six sites would be required at different locations across the province to handle the inorganic liquid wastes; the total number depending on the capacity of the sites. Large landfills of the size associated with major metropolitan areas and generally owned and operated by municipalities, would be the sites which could accept significant volumes of liquid industrial waste. Based

on experience in Metro Toronto such a landfill could probably accept up to 23,000 m^3 (5 million gallons) of liquid waste annually, but this would be dependent on the physical and hydrogeological properties of the site and on the amount of solid wastes received daily.

Once an appropriate site is located and approved for the co-disposal of liquid wastes, site preparation and support facilities can be completed and operational within six months. In Ontario, the expected lifetime of a co-disposal operation would be in the range of 10-20 years.

The added cost of handling liquids at a solid waste disposal site would include additional engineering cost to accommodate minor operational changes and increased monitoring. Capital costs will be dependent on land costs but can be expected to be in the range of $1-2 million for a 23,000 m^3 capacity site requiring a land area of approximately 40 ha.

4.1.3 Secure landfilling is a total containment or vault technique which isolates the waste from the immediate environment by the use of engineered systems including liners, collection tiles, and recirculation of collected leachate. The ability of the soils to prevent the migration of contaminants from the immediate site, known as attenuation, is only assessed for contingency use should the engineered design fail to operate as anticipated. In most cases, the wastes

are drummed and encased with absorbent or neutralizing material in order to minimize direct contact with the liner of the landfill cell. Any leachate collected is recirculated through the cell into the absorbent material or in some cases drummed.

Because of the complex design and engineering involved and the stringent management and operating procedures required, secure landfilling is normally employed only for sludges, solids and other wastes which cannot be treated for technological or economic reasons. The estimated cost of constructing a secure landfill with a capacity of 150,000 cubic metres is $1-2 million.

4.2 Deep Well Disposal

Injection of mixed liquid industrial wastes into porous layers of sedimentary rock or other geological formations dates back to the early fifties, although waste brines from oil and gas refineries have been disposed of in this fashion for several decades previous to this period. It is assumed that radial dispersion from the bottom of the well takes place upon injection at the well-head. Figure 2 presents an outline of the deep-well disposal process, and it can be seen that wastes may be injected in an untreated, partially treated, or highly treated "detoxified" state, depending upon the nature of the wastes and the chemical characteristics of the recipient formation. In most cases,

DEEP WELL DISPOSAL OF
INORGANIC LIQUID INDUSTRIAL WASTES

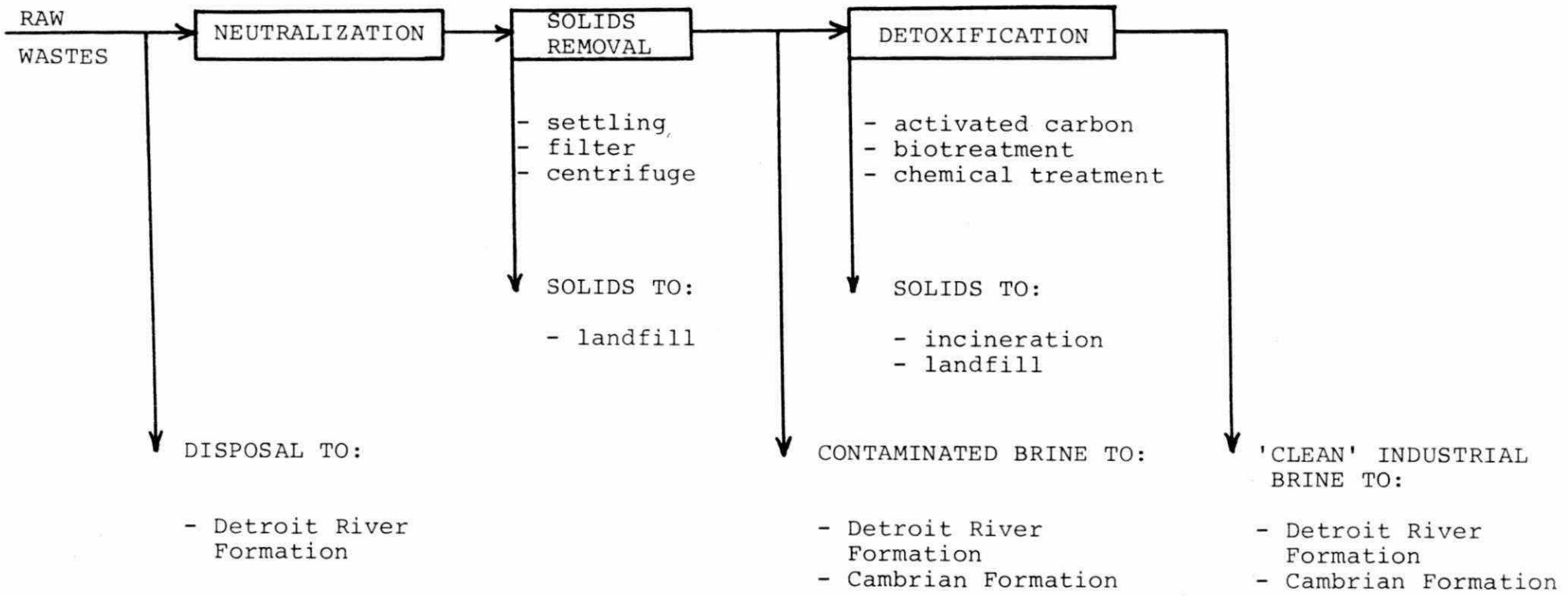

FIGURE 2

some form of pre-treatment such as filtration is required, and the residual solid or semi-solid wastes which result, require disposal in a secure landfill. There is the potential to recover the disposed liquid waste should this become desirable in future.

It should be recognized that sub-surface storage space available in geologic formations is a re-usable resource when used for temporary storage of natural gas, or for aquifer recharge for future use. This resource becomes unusable for an indefinite period of time, however, when taken up for the disposed of industrial wastes.

Locations suitable for deep-well disposal exist where there is an extensive, thick sedimentary sequence, where there is no major faulting or seismic activity, where low hydrodynamic gradients prevail over a wide area, and where there is no potential interference with in-situ resources such as oil, natural gas or metals not previously extracted. In Ontario, such conditions may be found in the Detroit River Formation near Sarnia, in the Cambrian Formation along the north shore of Lake Erie from the Niagara Peninsula to Windsor, and in the Guelph Formation. The Detroit River Formation was used for waste disposal in the late 1960's and early 1970's, injection taking place at a depth of 200-300 metres below the surface. The much deeper Cambrian and Guelph Formations (600m - 1400m) are considered preferable for such disposal, but only a few holes have actually been drilled in the townships of Sarnia, North Gosfield and Canborough.

Although many favourable sites are indicated by a mapping of the Cambrian Formation prepared for the Ministry by a consultant, past proposals for Cambrian disposal wells have been located at the few sites where test hole data were readily available.

Careful site selection, the use of adequate materials and safety systems such as pressure monitors and automatic shutdown mechanisms, complete waste analysis and compatibility testing, and appropriate pre-treatment can, with a very high degree of certainty, prevent mechanical failures and plugging of the well due to incompatibility of the injected waste with formation rock and fluids. More difficult to foresee, and therefore of greater concern, is the potential for contamination of other resources, both at and below surface, as a result of unexpected upward, downward or lateral migration of the wastes. This could result from natural or artificially induced faults in the confining rock beds, incorrect assessment of the formation's permeability, or the presence of unplugged or improperly plugged abandoned wells penetrating the disposal formation. This latter cause is potentially of greatest concern as waste fronts advance in their migration through the disposal formation. One estimate places the number of unplugged wells in the vicinity of the Detroit Formation disposal wells near Sarnia at 30,000.[1]

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1. R.O. Van Everdingen & R.A. Freeze, 1971; Subsurface Disposal of Waste in Canada, Technical Bulletin No. 49 p. 30 Inland Wastes Branch, Dep't of the Environment, Ottawa.

The same source reports the claim by the Michigan Department of Natural Resources that buildup of pressure resulting from deep-well disposal of chemical wastes near Sarnia caused two crude oil seeps and one natural gas seep from abandoned wells in Port Huron, Michigan. Unexpected migration of deposited waste liquids could also lead to contamination of ground and surface waters.

Because of these problems, disposal of liquid industrial wastes into the Detroit Formation was halted effective January 1, 1977. This prompted the Ministry to undertake a review of the deep-well disposal technology with input from recognized experts in industry and academia. Among the conclusions and recommendations of this review were:[2]

> "Based on the potential for impairment of ground or surface water, deep well disposal is preferable to disposal onto selected landfill sites or into surface waters."
>
> "In the disposal of liquid industrial wastes of all types, recovery, reclamation and re-use should be stressed. Incineration should be undertaken where applicable, and development work should continue toward improving chemical fixation and physical/chemical treatment processes. Subsurface disposal of treated industrial wastes should be limited to those wastes to which no other practical method of disposal can be applied, or reserved for emergency situations such as spills or treatment facility failures".
>
> "Long-term subsurface disposal should be confined to the Cambrian Formation or selected reefs in the Guelph Formation".

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2. Ministry of the Environment, April 1977; "Deep Well Disposal of Liquid Industrial Waste in Ontario - A Review".

These conclusions re-inforce one of the major conclusions arrived at by the previously cited authors, that:

> "Subsurface disposal of any waste should be discontinued as soon as an economical alternative treatment and/or disposal method, or a re-use or recovery process becomes available for such waste".3

It is estimated that the time necessary for development of a Cambrian disposal well is at least one year. Excluding pre-treatment costs, capital expenditures are estimated at $1 million, but will vary according to depth. Operating and maintenance costs can be expected to be in the order of $5/m^3 injected.[4]

4.3 Incineration

Incineration of industrial wastes using a rotary kiln, fluidized bed or direct suspension fired combustion chamber is a common method of treatment/disposal for the organic portion of these wastes, but not for inorganics. Typically, in the combustion of organic liquid wastes, stack emission controls are required with the result that secondary waste streams consisting of ash and brines from the scrubber operation require further treatment and disposal in a landfill or in a deep-well. When liquid inorganics are to be

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3. Op. Cit., see Footnote 1, p. 4-12

4. Cost estimates taken from James F. MacLaren Ltd., Development of Treatment and/or Disposal Sites for Liquid Industrial Wastes and Hazardous Wastes, August 1979.

treated by incineration, sufficient organics or supplementary fuel must be present to support combustion . If insufficient organics are present in the waste mixture to generate the necessary heat for the requisite time period, supplementary fuel such as bunker C must be added, increasing operating costs significantly. The principle underlying incineration or thermal oxidation of inorganic liquid wastes, is to utilize the heat generated by combusion of organic wastes to evaporate the water fraction, leaving a solid, inorganic waste residue or ash. Secondary waste streams resulting from this process are the same as those from organic waste incineration, except that the solid ash residues also include the residual inorganic compounds, and therefore require more careful disposal. Figure 3 illustrates two possible waste material flow patterns for incineration of inorganic liquid industrial wastes.

The only commercial waste incinerator operating in Ontario is the Tricil facility at Corunna. The Ministry received a proposal from this company to adapt its incinerator to handle up to 90,000 m^3 (20 million gallons) of inorganic liquid industrial wastes. The company proposed to use untried technology at an estimated capital cost of $5 million.

Construction of a new incineration facility equipped to handle organic wastes and having a capacity of approximately 25,000 m^3 of liquid wastes annually, is estimated to cost

INCINERATION OF
INORGANIC LIQUID INDUSTRIAL WASTES

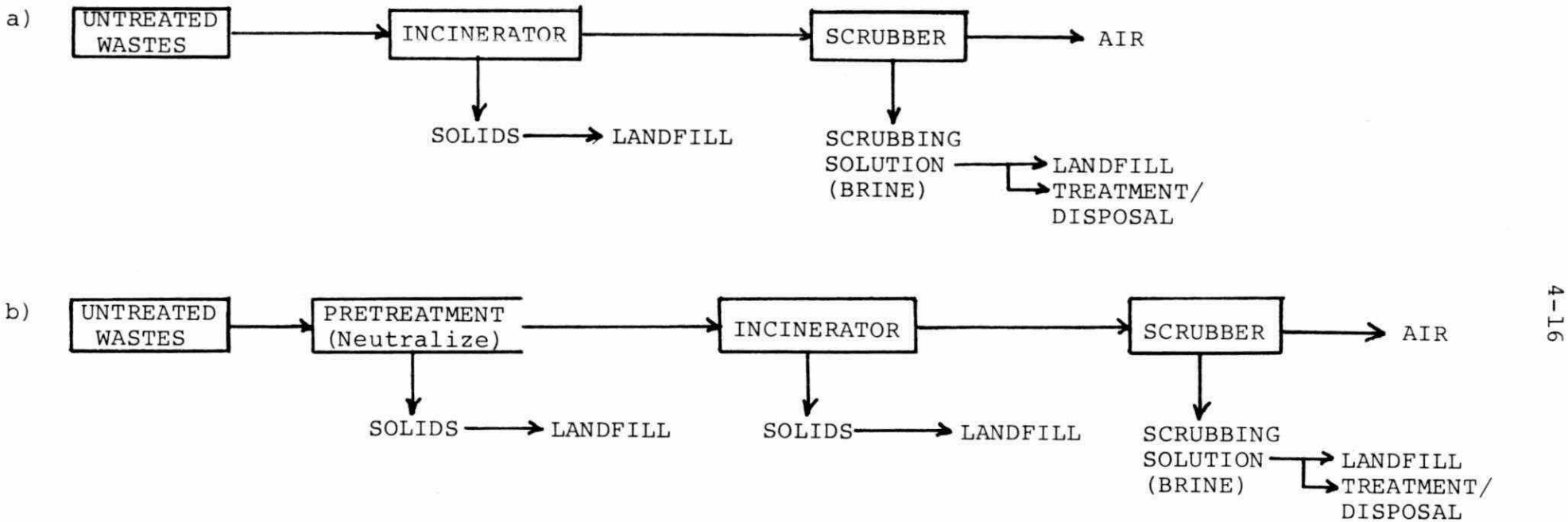

FIGURE 3

$16 million[5]. Modification to accommodate inorganic liquid wastes could raise these costs to between $20 million and $25 million. Operating costs are estimated at $60/m^3, plus fixed costs, and could go much higher if supplementary fuels are required. From the time approval is given, it is estimated that two years would be required until commissioning of an incineration facility.

4.4 Physical-Chemical Treatment

Physical-Chemical treatment is a term used to describe a number of processes which rely on physical and/or chemical phenomena to treat waste streams. These processes are generally selected to handle most of the inorganic waste streams commonly encountered in industry. The following process alternatives may be included:

- Chemical reaction such as neutralization or oxidation/reduction;
- Solids removal by sedimentation, flotation or filtration;
- biological oxidation
- Activated carbon adsorption;
- Reverse osmosis, ultrafiltration or electrodialysis;
- Ion exchange.

In constructing a waste treatment plant, those processes are selected which are deemed necessary to treat the types of waste available to the plant and consistent with the quality

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5. Cost estimate taken from James F. MacLaren Ltd., Op. Cit., see footnote 4, p. 4-14.

PHYSICAL/CHEMICAL TREATMENT OF
LIQUID INORGANIC INDUSTRIAL WASTES

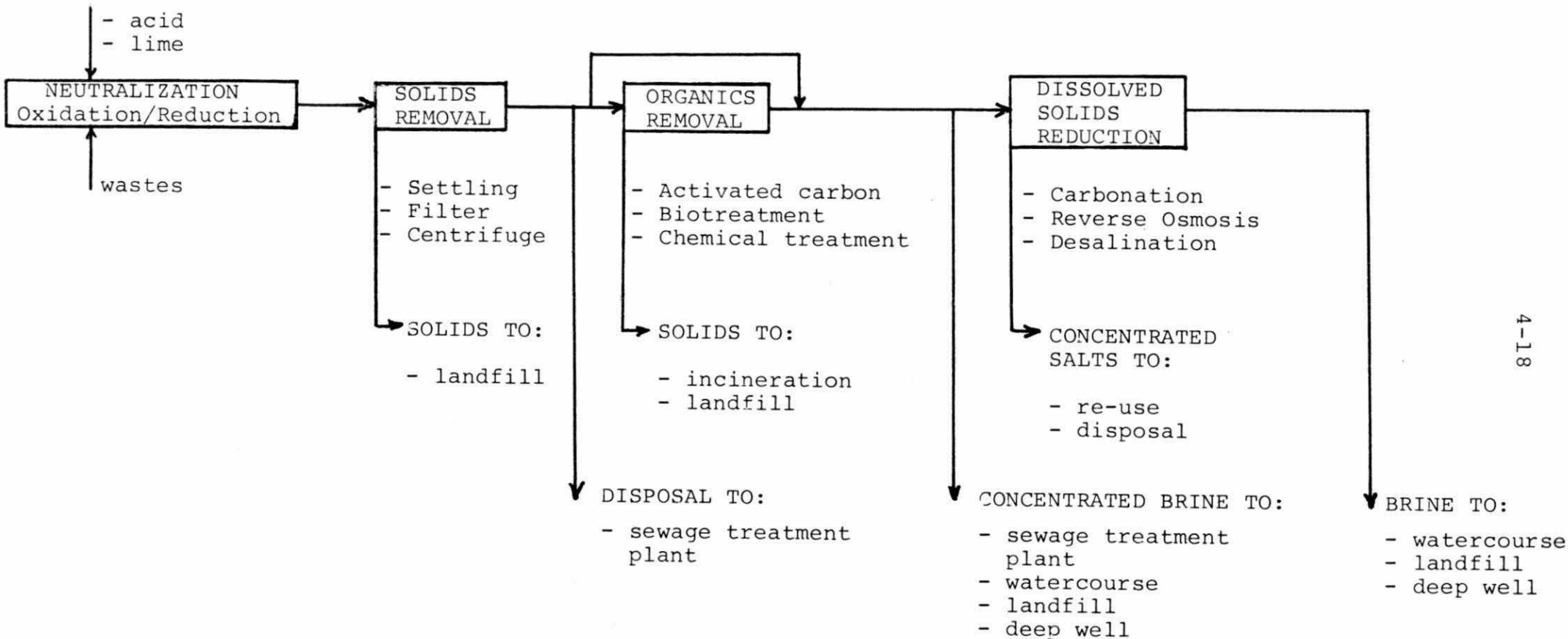

FIGURE 4

of effluent required for the selected method of disposal of the treated wastewaters. A number of process options are frequently available for each step.

Difficulties with this option include the cost of chemicals for some processes and the necessity to dispose of the solid residues in addition to the effluent "brines" which normally contain 1 to 2 percent dissolved solids.

Disposal of these brines to a sewage treatment plant is possible, but normally requires a plant with large capacity and also requires careful quality control of the brines to avoid upsetting the biological processes in the sewage treatment plant. The treated brines could also be disposed into a landfill site, but this would represent only a slight improvement over direct landfilling of the untreated liquid wastes since the contaminants present in these secondary waste waters are generally those which are not adsorbed or attenuated by soils and therefore, are precisely the ones which present the greatest potential for ground water contamination from a landfill operation. Direct release of treated brines to surface waters is possible provided the receiving waters are not highly sensitive and are sufficiently large to achieve adequate dilution. Effluent requirements established in accordance with the Ministry's Water Management Goals, Policies, Objectives and Implementation Procedures (the blue book) would have to be met. A final disposal option would be to inject the treated brines into a deep-well. This option is subject to all the advantages and problems discussed in section 4.2. In addition to the

disposal of treated wastewaters, secondary waste solids generated by the various processes must also be disposed of. These solid wastes are ideally solidified or deposited in a secure landfill at or near the treatment facility.

The main attempt at establishing a physical-chemical liquid waste treatment plant in Ontario was the recent proposal by Nanticoke Waste Management Ltd. to construct a treatment facility and landfill near the Nanticoke industrial park. The proposal went to a hearing before the Environmental Assessment Board and was eventually turned down. The reasons given by the Board for recommending against approval included:[6]

- inadequate information on landfill hydrogeology and long-term security;
- lack of planning for perpetual monitoring;
- potential for pollution of already marginal quality groundwaters;
- uncertainty about the adequacy of flows in the receiving creek to provide sufficient dilution;
- absence of a contingency plan or fund.

These reasons reflect the problems associated with the dual secondary waste streams resulting from the physical-chemical treatment process.

From the time of approval, it is expected that a facility of this type could be ready for operation within two years. The amount of land required would be approximately 4-6 hectares, excluding the landfill needed to accommodate

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6. Environmental Assessment Board, 1978, Public Hearings Nanticoke Waste Management Limited Waste Disposal Site.

the solid wastes produced. Capital cost of a facility capable of handling an average 380 m^3 (84,000 gallons) per day is estimated at $5-8 million, including storage tanks. The proposal by Durham Region to convert the Ajax sewage treatment plant into a physical-chemical waste treatment facility with a 115 m^3/day capacity is estimated to cost $2 million exclusive of land costs. Costs will vary widely depending upon the processes selected.

4.5 Solidification or Chemical Fixation

The concept underlying the solidification of liquid waste materials, is that a thickener or binding agent is added to the wastes or chemical reactions are induced to form a single sludge or solid, rather than separating out the solid and liquid components of the waste into two or more secondary waste streams. Making concrete using liquid wastes in place of water is a somewhat simplified analogy. Solidification is essentially a treatment step preceding disposal. Solidification process types applicable to inorganic wastes include cement-based techniques, lime-based techniques, encapsulation techniques and self-cementing techniques.

A number of patented and proprietary processes are potentially suitable including:

1. Canadian Waste Technology Inc. (Krofchak) process. This process is currently licenced to the Laidlaw Group and is being operated at the experimental facility at the Upper Ottawa Street landfill site in Hamilton.

2. Stablex - Seal-O-Safe process. This process is operated at two plants in Britain, one in the Netherlands and one in Japan. The company is actively trying to promote the process and establish facilities in North America at this time.
3. IU Conversions process. This process involves the utilization of fly-ash from thermal generating stations and has mainly been developed as a means of providing a solution to the fly-ash disposal problem. Liquid industrial wastes, in particular acids and alkalis, can be used as part of the chemical requirements for the process. The company operates at least two plants in the United States.
4. Soliroc process. The process, owned by the Belgian company Cemstobel, S.A. of Brussels, recently came to the attention of the Ministry and is currently being promoted in North America. The company is interested in licencing the process rather than building facilities but will also entertain joint venture projects.
5. Chemfix process. This process is the forerunner of the solidification processes and has been used in the United States for a number of years. It has generally been applied to in-situ solidification treatment of wastes stored in lagoons on company property. Browning-Ferris Inc. is successfully operating variations of this process at some of its centralized waste treatment facilities in the U.S.

Advantages of these processes are:

- that they use readily available raw materials which are often solid waste residues;
- that a relatively cheap, fast and simple technology is involved;
- that they are applicable to wastes with wide variations in chemical characteristics;
- that contaminant leaching can be reduced;
- that a usable product (eg. for gravel pit reclamation, road base material) may be produced;
- that the solidified product can be readily stored for ultimate disposal or reprocessing, as required.

Disadvantages include:

- the large bulk of materials which result;
- lack of knowledge about the long-term stability of the product material when landfilled;
- the potential leaching of chlorides, nitrates and sulphates from the solidified product;
- limitations on the amount of contaminating organic materials that can be handled;
- the need to pretreat some wastes (eg. to reduce organic content);

Figure 5 illustrates the basic solidification process steps. The ultimate volume of the solid product is generally in the range of one to two times that of the original liquid wastes. Leachates from the ultimate landfill may require

SOLIDIFICATION OF
INORGANIC LIQUID INDUSTRIAL WASTES

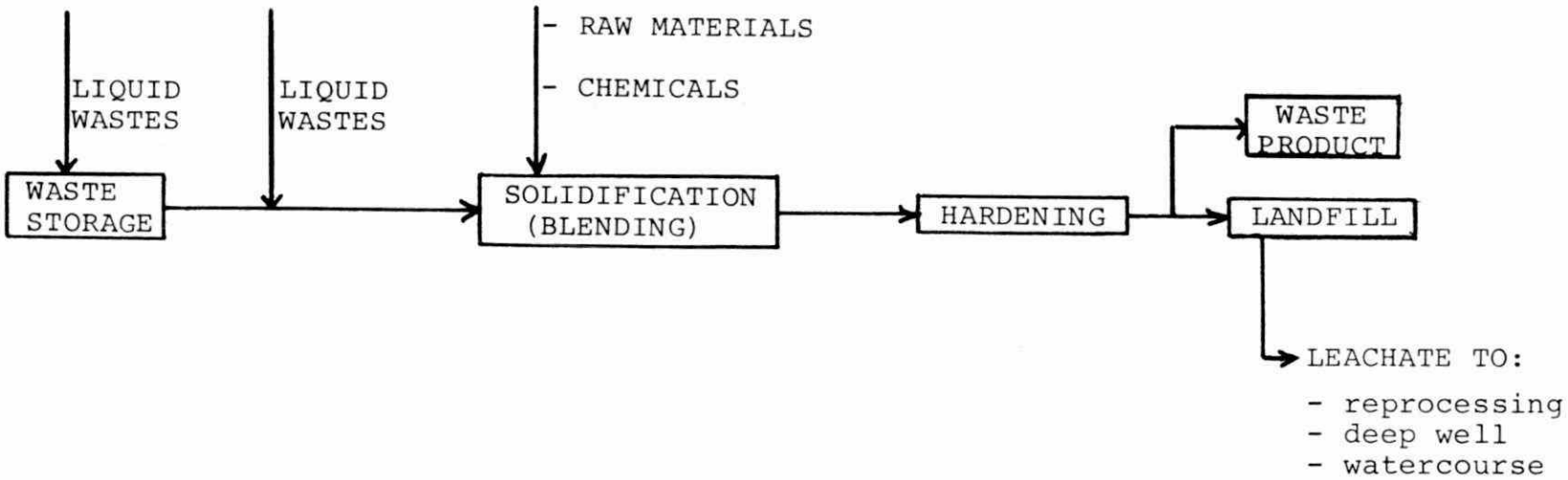

FIGURE 5

reprocessing, deep welling or discharge to surface waters depending on their quantity and quality. Until more is known about the nature of leachates generated by the solidified waste material, and about the long-term stability of this material, disposal or storage will need to be limited to landfill sites carefully engineered to permit leachate collection, site monitoring and surface drainage control. Information on these aspects of solidification can be gained by testing under genuine field conditions. In other words, a demonstration facility with careful monitoring will provide an opportunity to more fully assess the processes of chemical fixation or solidification of liquid industrial wastes.

A preliminary assessment of the Krofchak process was carried out by Ministry of the Environment staff in 1976. This assessment concluded:[7]

1. The solidification process appeared to hold and stabilize most of the heavy metals contained in the liquid waste. Heavy metal values in the leachates (laboratory and field) were commonly below 1 mg/litre;
2. Leachates from the testing of processed material contained high concentrations of dissolved solids;

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7. Ontario Ministry of the Environment, 1976; An Assessment of a Process for the Solidification and Stabilization of Liquid Industrial Wastes.

3. The bulk of the common heavy metals present in the waste were retained in the processed material during extended periods of leaching with distilled water when considered on a mass basis, i.e. losses of heavy metals were relatively minor;
4. Landfilling may be used to dispose of the processed material providing adequate facilities are available for the collection and treatment of leachate and run-off. The concern over dissolved solids contamination at the disposal site will dictate the adequacy of the facilities required.

Data made available to the Ministry on other chemical fixation or solidification processes tend to similar conclusions, however, the results of this preliminary assessment of one process should not be assumed to apply equally to all solidification or chemical fixation processes. A facility processing 380 m^3 per day of liquid industrial wastes, assuming a 1:1 ratio of liquid waste to solid products would produce approximately 140,000 m^3 of solid product annually requiring a disposal area of approximately 1.5 ha (3.7 acres) if piled to a depth of 10 m. The disposal site would have to incorporate leachate collection, surface drainage control and site monitoring.

The capital cost of constructing a solidification facility capable of handling 60 m^3 per day (5 million

gallons per year) of liquid wastes is estimated to be in the order of $1 million, excluding development of the disposal site. Operating costs vary significantly depending upon the waste characteristics, but can be expected to range from $8 to $15 per m^3 of liquid wastes treated.

4.6 Interim Storage

The option of temporarily storing all liquid industrial wastes generated in the period until a long-term plan is developed, approved and implemented must also be considered. Most industries which generate these wastes do not have the capability to store them for extended periods. Therefore, some kind of central storage facility must be envisaged. Such storage could be accomplished either in bulk storage tanks or in steel or plastic drums. The major considerations in storage are that only compatible wastes are mixed, and that storage areas are properly designed to protect against the elements, vandalism and environmental contamination in the event of leakage or accidental spillage. Storage must be undertaken in a carefully controlled manner to eliminate the potential for adverse chemical reactions which may produce noxious gases or cause chemical precipitation and to minimize hazards such as container breakage, overheating of wastes in the summer and the freezing of wastes in winter.

Considering bulk storage first, it is estimated that at least fifteen two-million-gallon tanks would be needed to store the wastes produced each year, at an

estimated cost of $15 million. To accommodate fifteen tanks, a site approximately 4 ha (10 acres) in area would be needed. Assuming tanks could be rented, the cost of storage is estimated at $2.25 million (15% x $15 million) per annum. It should be noted that these are conservative estimates, since more than 15 tanks may be needed in order to keep incompatible wastes separated, and since more than a 15% return on capital investment may be required by facility owners due to high inflation. The minimum cost of bulk storage, therefore, is estimated as follows:

	$ millions
1st year	2.25
2nd year	4.50
3rd year	6.75
4th year	9.0
5th year	11.25
TOTAL	33.75

The average annual cost for the five year period is therefore estimated to be at least $6.75 million plus the cost of site security, and a total of approximately 20 ha (50 acres) would be required for the bulk storage facilities. Preliminary enquiries within the province turned up only one potential storage facility, an oil tank farm with 25 million gallons of redundant tank capacity. Upon investigation, however, the location of this facility proved to be unacceptable due to its proximity to Lake Ontario and poor soil conditions.

Considering drum storage, 800,000 drums of 37.5 imp. gal. capacity would be required to store 30 million gallons of waste. New steel drums cost $17.65, reconditioned ones

$12.00 each and, where needed, protective liners and gaskets will add $5.00 per barrel.[8] Assuming an average cost of $15.00 per barrel, storage costs exclusive of land or warehousing, security and environmental design costs, would equal $12 million annually. Assuming drums could be stacked three high on pallets for storage, a total of 800,000 sq. ft. or some 7.2 ha (18 acres) of storage area would be required annually; the equivalent of 36 ha (90 acres) over the 5 year period.

Aside from the high economic cost of interim storage, there are the added risks associated with the double handling of all the wastes (eg. accidents, spillage) and the difficulty of ensuring security from vandalism over a period of several years. Additional costs of loading, transporting and unloading all the wastes a second time, once their ultimate disposal has been determined, must also be considered.

4.7 Re-use, Recycling and Recovery

As noted in Chapter 3, there are a large number of specific processes available which extract valuable components from particular types of waste streams; primary among these are metals recovery processes. Wastes from some industrial processes can also be recycled or re-used "as is" in other manufacturing processes. Examples include:[9]

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8. Personal communication from National Drum Ltd.

9. Taken partly from James F. MacLaren, Op Cit.

- recovery of oil for recycling and/or for fuel;
- recovery and re-use of metals from metal finishing wastes, e.g. electroplating wastes;
- recovery and re-use of solvents by distillation, or direct reuse of contaminated solvents as fuels;
- upgrading and reuse of refinery waste caustics for use in pulp mills;
- re-use of spent acids and alkalis for neutralization of one with the other in waste treatment operations.

Unfortunately, there has been little incentive for private industry to establish centralized waste recycling or recovery facilities given the generally cheaper costs of raw materials and chemicals which have prevailed. Increases in energy costs and the scarcity of certain raw materials may create favourable changes in the economics of centralized waste recycling facilities.

On-site recycling or recovery operations are operated by individual companies where they can be economically justified. For example, a number of plating companies recover nickel from waste waters for reuse, and operations using precious metals such as gold and silver invariably treat all wastes to recover as much of these precious metals as possible prior to discharge. Cutting fluids used in machine shops are also often reclaimed, cleaned and then reused where formerly they were discarded. It is also quite common for industries using solvents to reclaim waste solvents either for reuse or for use as fuels in power boilers. In most cases, however, where relatively small quantities of waste are produced, often at irregular intervals, it is not economical for the

generator to invest capital in recycling or recovery facilities. Furthermore, many companies are reluctant to become involved in waste treatment processes for which they have no expertise.

A major effort at promoting the re-use and recycling of wastes across various industrial sectors is the Canadian Waste Materials Exchange program established by the Federal government in 1977 and operated under contract by the Ontario Research Foundation. The Exchange provides companies with a means to advertise the nature and quantities of their wastes with a view to contacting other manufacturers who may be able to make use of these wastes. On October 1, 1979 there were 5800 companies participating in the Exchange, 1104 wastes were listed, and 80,000 tons of wastes had been transferred in the preceding year.[10] In the period January 1978 to September 1979, of 837 wastes listed (excluding the Miscellaneous category), 271 (32%) were inorganic (both solids and liquids). From these listings, 126 transfers were made, 28 (22%) of which involved inorganic wastes. Ontario accounted for 65% of all transfers made.[11] In the 23 month period from January 1, 1978 to December 1, 1979 it is estimated that 1100 m^3 (250,000 gallons) of liquid

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10. Canadian Waste Materials Exchange, Bulletin No. 12, November 1979; Ontario Research Foundation, Mississauga.

11. Canadian Waste Materials Exchange, "Summary of Activities", December 1979.

industrial wastes were transferred through the Exchange. Applying the 65% figure to this volume yields an estimated annual transfer of liquid industrial wastes for Ontario of approximately 390 m^3 (85,000 gallons), or less than 0.2% of the total generated each year. While the Canadian Waste Materials Exchange is an excellent program which the Ministry will continue to support, it cannot be considered at this stage in its development as providing any significant relief for Ontario's liquid industrial waste disposal problem.

Chapter 5 EVALUATION OF ALTERNATIVES

The evaluation of the alternatives presented in Chapter 4 consisted of a review of these options with reference to a number of criteria and in light of the objectives outlined in Chapter 2. To recapitulate briefly, these objectives are:

1. To provide limited-term facilities for the management of inorganic liquid industrial wastes in the Province of Ontario;

2. To provide these facilities as quickly as possible and in a manner which will best serve the interests of Ontario.

5.1 Evaluation Criteria

Criteria used in the evaluation of alternatives for the limited-term treatment and disposal of inorganic liquid industrial wastes have their origins in the nature of the problem described in Chapter 3, and in traditional considerations of engineering and economics. The time required to implement each alternative subsequent to approval was considered an important factor, because of the urgent need to establish these facilities and the limited-term nature of the facility being proposed.

Previous efforts to establish appropriate inorganic liquid waste management facilities failed, largely due to opposition from special interest groups and local citizens. It can be expected that any proposal for the centralized management of liquid industrial wastes will meet with opposition at the local level, but the task of the Ministry

is to provide waste management facilities which will best serve the interests of the people of the Province as a whole. Local concerns frequently relate to siting factors such as site location, land requirements and the number of sites required. It is imperative, therefore, that general siting requirements be given careful consideration in assessing the technological options with a view to minimizing local concerns while meeting the requirements of the technology. Thus, the second criterion used to evaluate the technology alternatives is that of siting requirements.

Because any facility being proposed must receive approval from the Ontario Government, consistency with present government policy on liquid industrial waste disposal, as enunciated by the Minister of the Environment in his seven-point program announced to the Standing Committee on Resource Development on October 18, 1978 was considered an important criterion. Government policy reflects the goals and values of society at large and consistency with these goals is considered an important measure of the appropriateness of a project.

Engineering and technical considerations break down into three distinct criteria, namely the reliability and the flexibility of the technology being employed, and thirdly, the nature of any secondary waste streams which result. Reliability of the technology is assessed on the basis of historic experience as well as theoretical understanding of the processes involved. Technology flexibility relates to the ability of the technology under consideration to handle

wastes of various and varying characteristics. The greater the variety of wastes which can be accommodated, the more advantageous the technology. The nature of any secondary waste streams is important, insofar as it affects the method of disposal and therefore may be considered a measure of the effectiveness of the treatment option.

Economic considerations focussed on projected cost to the user derived from capital and operating cost estimates. Data were frequently difficult to obtain and estimates are approximate. Also, considerable variations will occur depending upon the specific process employed.

It is important to point out that there are essentially three categories of alternatives under consideration. The first category consists of options in which little or no man-made treatment of wastes is proposed and perpetual storage/disposal or natural attenuation of contaminants is favoured. This category includes the no change option, the landfill option and the deep-well disposal option. The second category includes the incineration, physical-chemical treatment and solidification options, all of which attempt to minimize the potential dangers and uncertainties associated with waste disposal by first neutralizing or "fixing" potentially hazardous contaminants before disposal. These options do not avoid disposal into the natural environment, but they reduce the risks and uncertainties associated with disposal. The last category, interim storage, involves neither treatment nor disposal.

In summary, the criteria applied in the assessment of the altenatives considered for the limited-term treatment of inorganic liquid industrial wastes are as follows:

1. Time required from approval to commissioning of a facility.
2. Siting requirements, taking into account site location, land requirements, and number of sites required.
3. Consistency with Ontario Government policy on the disposal of liquid industrial wastes.
4. Engineering considerations including the reliability of the technology, the flexibility of the technology to handle different kinds of waste, and the nature of any secondary waste streams which result.
5. Projected cost to user.

5.2 Comparative Assessment

This section presents an assessment of the alternatives considered in accordance with the criteria set out in section 5.1. The alternatives are discussed and compared for each criterion successively. Table 5.1 presents a summary of the assessment. The seven alternatives considered are:

1. No change.
2. Co-disposal in landfill.
3. Deep-Well disposal.
4. Incineration.
5. Physical-chemical treatment.
6. Solidification.
7. Interim storage.

TABLE 5.1

COMPARATIVE ASSESSMENT OF ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF INORGANIC LIQUID INDUSTRIAL WASTES IN ONTARIO

CRITERIA	TIMING AFTER APPROVAL	SITING REQUIREMENTS	CONSISTENCY WITH GOVERNMENT POLICY	ENGINEERING - technology reliability and flexibility - nature of secondary waste stream(s)	ECONOMICS Capital Cost of Facility 380 m^3/da capacity	ECONOMICS Operating Cost
ALTERNATIVES						
1. No change	N/A	- disposal into 23 sites many of which are not appropriate.	- policy objectives not met - limited control of wastes.	- wide range of wastes can be handled. - degree of containment uncertain; high risk of groundwater contamination. - potential increase in leachate quantity and change in quality.	N/A	minimal
2. Co-disposal in landfill	within 6 months	- five or six sites required - approx. 40ha land required including buffer zones for each of five or six sites - expect difficulty finding sites since good agricultural land often involved.	- ban on landfilling of untreated wastes is imminent - limited control of wastes.	- wide range of wastes can be handled. - leachate collection and treatment required. - uncertainty in ability to predict fluid movement through soil which creates potential risk of groundwater contamination.	$6-12 million (6 sites)	minimal
3. Deep-well disposal	12-18 months	- one or more sites required - 4-6ha required per site - geological formations generally underlie good farmland - additional land may be required for disposal of solid residues from pretreatment.	- consistent with policy - limited to Cambrian and Guelph formations.	- suitable geological formations available in Ontario. - technology widely used in U.S. which suggests high reliability. - waste types limited by compatibility with receiving formation and ability to be pre-treated. - solid residues from pre-treatment require disposal.	$1 million, plus cost of pre-treatment facilities (one well only)	$5/$m^3$ plus cost of pre-treatment facilities
4. Incineration	2 years	- one site approx. 4-6ha required - additional land may be required for solid waste residue disposal	- consistent with policy - air quality requirements must be met.	- highly reliable with many years experience. - capable of handling almost all wastes. - ash residues require disposal. - scrubber solutions must be treated, released to STP or watercourse or deep-welled. - air emissions must meet air quality requirements.	$25 million +	
5. Physical/ chemical treatment	2 years	- one or two sites required - 4-6ha required per site - additional land may be required for solid residue disposal	- consistent with policy - effluent quality must be consistent with water quality objectives for receiver.	- with good design and operation, technology is reliable. - can be designed to handle wide range of wastes. - treated wastewaters contain dissolved solids which may impact on receiving water quality. - solid residues require disposal. - extensive monitoring and control of effluent required.	$5 million +	less than $15/$m^3$
6. Solidification	within 12 months	- one or two sites required - approx. 3ha required per site - additional land may be required for solid product disposal	- consistent with policy - leachate characteristics must be consistent with water quality objectives.	- several years experience internationally which suggests high reliability. - limited data on product stability as it relates to disposal. - wide range of wastes can be handled. - solid product with volume equal to or greater than original liquid must be utilized or disposed.	Approximately $5 million	$8-15/$m^3$
7. Interim storage	3 months	- one or two sites required - 10-20ha required per site	- acceptable - tight security and site monitoring required.	- can be designed to handle all wastes with little risk of contamination during storage. - ultimate treatment and/or disposal still required. - particular care required to avoid leakage and accidental spillage. - increased environmental risk due to requirement for double handling	a) bulk: $75-100 million b) drum: less than $1 million	more than $49/$m^3$ more than $86/$m^3$

Re-use, recycling and recovery were not included because it was concluded from evidence presented in section 4.7 that this option was not capable of dealing with Ontario's inorganic liquid waste disposal problem at this point in time.

5.2.1 Timing

The timing criterion is not relevant to the no change option. Options 3, 4 and 5, all of which require in excess of one year for completion subsequent to approval are not consistent with the objective of providing facilities as quickly as possible. From a timing standpoint, therefore, the preferred options are co-disposal in landfill, solidification, and interim storage.

5.2.2 Siting Requirements

The no change alternative does not require additional sites. However, current practices involve the landfilling of liquid industrial wastes in sites which do not meet present-day siting requirements.

The second option, co-disposal in landfill, requires five or six sites. All other alternatives, with the exception of the no change alternative, require only one or two sites.

Good landfill conditions are frequently coincident with good agricultural soil conditions. Similarly, potential deep-well disposal sites are generally located in agricultural areas and it is considered preferable to avoid the taking of good agricultural land for non-farming purposes. Geological

and hydrogelolgical considerations may place more severe location constraints on options 2 and 3 than on other options. Also, option 5 requires a location adjacent to a large receiving body of water or a sewage system capable of accepting the process effluent.

With respect to land requirements, options 4 and 5 are very similar, requiring an estimated 4-6 ha at each of one or two sites, discounting the need for landfilling of residues. Option 6, solidification, requires less land for the actual processing facility, but may carry with it a requirement for disposal sites if no suitable use can be found for the solid product. Option 7, interim storage, requires a somewhat greater area (approximately 40 ha).

On the basis of the preceding, it appears that the siting requirements associated with options 4, 6 and 7, incineration, solidification and iterim storage, can be more readily met than those associated with the other options.

5.2.3 Consistency with Government Policy

The no change alternative does not meet the objective of providing limited-term facilities for the management of liquid industrial wastes. The co-disposal of these wastes as currently practised is a no-choice option which can best be described as non-management, insofar as these wastes are being widely dispersed throughout the province, and once deposited at the sites, there is virtually no control over what happens to them. Few sites are adequately monitored

and if problems arise the liquid wastes deposited cannot be reclaimed; only the symptoms, not the cause, can be treated. For these reasons, the Government has signalled its intent to ban direct landfilling of liquid industrial wastes, and the Waste Management Branch of the Ministry of the Environment, has initiated the process culminating in the project proposal.

Co-disposal in landfill has all the same disadvantages as the no change option, except that the risks of waste migration and resulting environmental contamination are reduced, and problems are likely to be discovered more quickly due to proper monitoring. The method of landfilling of liquid industrial wastes is, nevertheless, contrary to the stated policy of the Minister of the Environment which applies equally to all landfill sites.

The deep-well disposal option is consistent with Government policy, provided disposal is into the Cambrian or Guelph Formations. Disposal into the Detroit Formation has been halted due to problems encountered at Ontario and Michigan wells which penetrate this relatively shallow formation.

The remaining four options are consistent with current Government policy, provided appropriate disposal and careful monitoring of all effluents and residuals is included in the project design, and all air and water quality requirements of the Province are met.

5.2.4 Engineering and Technical Considerations

The technical aspects of all the alternatives have been described in detail in Chapter 4. A review of the summary in Table 5.1 reveals the following comparative highlights. Current landfill disposal practices are technically unacceptable because of the uncertainty of contaminant containment and the associated high risk of groundwater contamination. Co-disposal into landfills can be technically acceptable provided the receiving sites are carefully chosen for optimal soil and hydrogeologic conditions, and engineered to include site monitoring, surface drainage management and leachate collection and treatment. Nevertheless, the uncertainty of predictions of fluid movement through soil results in some potential for contamination of groundwater in this alternative.

In comparing options 3, 4, 5 and 6, they can all be designed to be reliable, as indicated by experience in Ontario and in other jurisdictions. Deep-well disposal is not as flexible as the other technologies, however, insofar as it is limited to wastes which can be pretreated for solids removal and compatibility with the receiving geologic formations. With respect to the secondary waste streams, there is some risk of polluting receiving waters with effluent from a physical-chemical treatment plant and incineration facility. Solidification offers the advantage that only one secondary waste stream (solid product) results, compared to two or three for the other technologies.

Furthermore, this solid product can be readily monitored, relocated if necessary, and may even have beneficial uses. By contrast, in the physical-chemical treatment process, failure to achieve effluent quality acceptable for release to the receiving watercourse or sewage system would require re-treatment, or could result in premature facility shutdown if adequate storage capacity is not available.

The major technical disadvantage of the interim storage option is the increased risk of accidents and spillage due to double handling of all wastes.

From our review of these options, we have concluded that little differentiates them one from another on technical grounds, with the exception of landfilling. The inability to guarantee the containment, attenuation or dilution of contaminants in landfill operations distinguishes this option as technically inferior.

5.2.5 Economics

The data in Table 5.1 indicate that options 1, 3 and 7b are to be preferred from the standpoint of capital costs. Option 7b is rejected on the basis of its high operating costs, however. Furthermore, if more than one deep well is required due to limited well capacity, the capital cost of option 3 could approach those of options 2, 5 and 6 and the operating costs of option 3 could also increase significantly

due to pretreatment costs. Although operating costs for option 5 will vary considerably depending upon the type of physical/chemical processes employed, for the majority of wastes they are not expected to exceed $\$15/m^3$. Operating costs of option 2 will consist primarily of additional security and monitoring requirements at landfill sites.

Clearly option 1, the no change alternative is to be preferred from a strictly economic standpoint. Given the approximate nature of the estimates available, options 2, 3, 5 and 6 may be ranked in second place. Options 4 and 7 are least preferred.

5.2.6 Summary Assessment

Table 5.2 presents in summary form the alternatives preferred according to each criterion, based on the foregoing discussion.

TABLE 5.2 PREFERRED ALTERNATIVES BY CRITERIA

	ALTERNATIVES						
CRITERIA	1	2	3	4	5	6	7
Timing		x				x	x
Siting Requirements				x		x	x
Consistency with Gov't Policy			(x)	x	x	x	x
Engineering			x	x	(x)	(x)	x
Economics	x	x	x		x	x	

In Table 5.2, an 'x' opposite the criterion in the left column indicates the alternative meets that criterion. Where the 'x' is bracketed, the criterion is met provided certain measures are included in the proposed alternative, such as monitoring programs or site restrictions. For the criterion 'timing', alternatives which could be implemented within 12 months of the date of approval were given 'preferred' status. The no change option ranks highest from an economics standpoint but because of the difficulties associated with this option, options 2, 3, 5 and 6, which ranked second, were also given preferred status.

The summary table indicates that the interim storage option (#7) was a close second to the solidification option (#6). Option #7 was rejected, however, due to the considerably higher costs involved. Over the five year period, total capital and operating costs for interim storage would be at least $61 million (excluding secondary hauling and treatment/disposal) or more than five times higher than for solidification.

On the basis of this assessment, the Waste Management Branch received concurrence from the Ministry's senior management to proceed with a strategy to provide limited-term, inorganic liquid industrial waste solidification facilities.

CHAPTER 6 STRATEGY IMPLEMENTATION

Having selected the technology to be used in meeting the limited-term inorganic liquid industrial waste disposal needs of the Province, it was necessary to consider where such a facility or facilities should be situated, and who should own and operate it (them). The following options were apparent:

1. A government facility on Crown land with the operation of the facility being contracted out;
2. A private sector facility on Crown land, based on a request-for-proposal approach;
3. A private sector facility on privately-owned lands, again based on request for proposals;
4. A joint government/private sector approach on either Crown land or private land.

It was reasoned that construction of the facility on Crown land would offer greater assurances to the public that any liabilities resulting from the temporary storage of the solidified product would be met because the government owned the land. Crown and other lands reviewed by M.M. Dillon Consulting Engineers, in their study of suitable sites for interim storage of PCBs, were assessed as to their potential for this purpose. Parcels of land identified were found to be unsuitable because they were not situated near the major centres of waste generation (Toronto-Hamilton and Sarnia, see Figure 1), because they were associated with recreational facilities and institutions, or because they were located in environmentally sensitive areas. The property in Mississauga

where the Tricil incinerator is located, and the South Cayuga (Region of Haldimand/Norfolk) properties appeared most promising, but were rejected at the time in favour of approaching the private sector. The Mississauga property was considered to be located in an area where the public could be expected to mount excessive opposition and the Cayuga property is essentially undeveloped and would require considerable work to provide the needed infrastructure of road access, power, water, etc. Also, the site was only available as a 5000 ha parcel, an area far in excess of that needed for the project.

It was considered unlikely that the private sector would respond to a call for proposals to provide limited term facilities at this time without incentives. The course selected, therefore, was to enter into a joint government-private sector program, on private lands, with the government offering to underwrite the cost of the environmental hearings up to a maximum of $100,000.00, and to take responsibility for the cost of removing the stock-piled solidified material to an appropriate location for disposal. These incentives would only apply if the application for approval was denied as a result of the hearing process, and if the site at which the facility was constructed proved unsuitable for ultimate disposal. An option remaining open for future consideration is that the Government purchase the site associated with any proposal should this appear advantageous.

6.1 Call for Proposals

In mid-1979, Management Board of Cabinet approved the policy as described and allocated the funds necessary to meet the financial commitments inherent in the policy. Furthermore, any proposals selected to construct the required facilities were to be subject to The Environmental Assessment Act in accordance with the stated policy of the Minister. One benefit of this policy is that it affords an opportunity for full public scrutiny of these proposals before a decision is made.

Subsequently, the Waste Management Branch called for proposals to construct and operate limited-term solidification facilities as follows:

1. A request for proposals was forwarded directly to a number of companies known to have operations in the liquid waste management field, or access to a solidification or chemical fixation process through patent or proprietary rights.

2. Information about the request for proposals was disseminated throughout the United States via the National Solid Waste Management Association of Washington, D.C.

3. Advertisements were placed in Toronto and Windsor newspapers, and in a number of select trade journals.

By July 3, 1979 a number of companies had expressed interest in response to these notices. The deadline for receiving proposals from these companies was set at no later than August 15, 1979. Appendix I-E includes a copy of the request for proposals and covering letter as well as a list of companies which received the request for proposals.

By August 15, 1979, submissions had been received from the following companies:

1. Browning-Ferris Industries;
2. Canadian Waste Technology;
3. Frontenac Chemical Waste Services;
4. I.U. Conversions;
5. MBL International Contractors Inc.;
6. Stablex Canada;
7. Woodington Systems Inc.

All proposals have been treated in a confidential manner because a number of companies indicated that their submissions contained information which they did not want divulged to the public or to their competitors.

In August, 1979, the Minister of the Environment received an unsolicited proposal from Tricil Waste Management Ltd. to establish facilities for the treatment of inorganic liquid industrial wastes at the company's site in Corunna, Ontario. Although the proposal involved a technology other than solidification, it was considered to have sufficient merit that the Minister directed it be evaluated along with the other proposals received.

6.2 Proposal Evaluation and Selection

A proposal assessment committee was established consisting of two chemical engineers from the Waste Management Branch, one chemical technologist from Regional Operations Division, Central Region, one biologist from the Environmental

Approvals Branch, and one economist from the Program Planning and Evaluations Branch, all within the Ministry of the Environment. Initial screening permitted the committee to eliminate two of the proposals. The I.U. Conversions proposal was rejected because the Company did not specify a site. The MBL International Contractors Inc. proposal was rejected because it did not involve the use of a recognized solidification process, because it involved significant capital and operating costs to the government in comparison with other proposals, and because the company has no experience in waste management.

The Minister and senior Ministry staff met with the remaining six companies on October 11, 1979. It was agreed at this meeting that the Ministry would select two proposals from the six, and that the companies would abide by the Ministry's selection. The decision to select two proposals took into account the following:

1. industry's contention that the market could not support more than two solidification facilities at this time;
2. the desirability of maintaining a competitive situation;
3. the ability to demonstrate more than one solidification technology.

Following this meeting, the proposal assessment committee adjusted its terms of reference to read as follows: "On or before October 26, 1979, to select two proposals from the six under consideration consistent with the objectives below:

1. to evaluate the technical validity and relative merits of the various processes being proposed, with emphasis on the range of wastes which can be handled;
2. to compare the projected disposal costs associated with each proposal to ensure a reasonable cost to the user;
3. to compare the cost to the government in terms of a stated commitment to support the cost of an environmental hearing and the disposal of solidified products;
4. to assess the proposals with respect to their potential success in obtaining environmental approval recognizing the proposals would be subjected to The Environmental Assesssment Act."

In addition, the committee took note that the proposals would be assessed as limited-term facilities, not as permanent facilities.

More specifically, the evaluation of the proposals took into account the following considerations:

i) Amount of time required to commission the facility subsequent to approval;

ii) Projected cost to the user as stated in the proposal;

iii) Potential cost to the government to fulfill its commitment to support the cost of submission preparation for and presentation to the necessary

environmental hearings, if approval is not granted, and to remove the solidified product to a suitable disposal site, if the proposed site is found to be unsuitable for this purpose;

iv) Suitability of the proposed site, taking into consideration;

a) site availability,
b) existing use,
c) surrounding land use,
d) environmental sensitivity,
e) hydrogeology,
f) capability for long term disposal vs. short term storage of solid product,
g) road access and site preparation requirements,

v) Engineering and technical considerations, including;

a) companies' experience in the management of liquid industrial wastes,
b) record of companies' existing operations,
c) range of wastes the proposed process can handle,
d) operating experience using the proposed process, and supporting technical data,
e) comprehension of and compliance with the terms of reference, as demonstrated in the proposal submissions.

It was felt that if the above factors were optimized, then a site and process acceptable to the public, the government and the industry, and which are also technically and economically viable, would result. It must be recognized, however, that in any given proposal each individual factor may not be independently optimized. Rather, each proposal consisted of a package, combining a specific process, site and company which could not be separated one from another. It was necessary, therefore, to evaluate the proposals as a whole.

This was done by assessing what were considered to be the major advantages and disadvantages of each proposal. Table 6.1 highlights for each proposal the major factors considered in the evaluation.

With respect to the amount of time required subsequent to approval, it can be seen from table 6.1 that little differentiates the proposals one from another. An advantage of the proposal by Canadian Waste Technology Inc., however, is that it has the capability of receiving wastes within six weeks and storing then until the treatment facility is completed.

It is extremely difficult to evaluate the Stablex (Canada) proposal from the point of view of cost to the user because of the extremely wide range stated by the company. Although the proposal by Tricil Waste Management Ltd. did not include a cost-to-user estimate, the company provided assurances that these costs would be competitive. The other four proposals were considered to be within an acceptable range of user costs, and were not significantly different, one from another.

The major difference among the proposals insofar as potential cost to the government is concerned, is that two proposals relieved the government from its commitment to relocate the solid product, if necessary. Canadian Waste Technology Inc. proposed to use the solid product, for land reclamation, landfill cover or as road base material. If the product were found not acceptable for any of these uses, the

TABLE 6.1

SUMMARY EVALUATION OF PROPOSALS TO CONSTRUCT LIMITED-TERM LIQUID INDUSTRIAL WASTE MANAGEMENT FACILITIES

	C R I T E R I A				
	TIMING AFTER APPROVAL	COST TO USER	POTENTIAL COST TO GOV'T	SITE SUITABILITY	ENGINEERING AND TECHNICAL
1. Frontenac Chemical Services Limited	6-9 months	$\$44/m^3$	Hearing plus solid product removal	- adjacent to Flamboro-Steetley Quarry - poor hydrogeology - substantial public opposition expected	- experience in liquid industrial waste management - demonstrated process; can handle some organic content - criticism of existing operations in Hamilton - proposal goes beyond terms of reference.
2. Canadian Waste Technology Limited	- 6 months - can begin receiving wastes within 6 weeks	$\$10-110/m^3$	Hearing costs only	- former Imperial Oil bulk storage facility on Commissioner Street - capability for five-year storage of solid product, but not for product disposal	- limited experience in liquid industrial waste management - demonstrated process - insufficient quality control included in process design - can handle some organic content.
3. Stablex (Canada) Limited	8 months	$\$5.50-1100/m^3$	Hearing plus solid product removal	- site of Ajax sewage treatment plant - availability of site to proponent uncertain - only limited storage, and no disposal capability.	- experience in liquid industrial waste management - demonstrated process - can handle some organic content.
4. Browning-Ferris Industries	5-8 months	$\$42-97/m^3$	Hearing plus solid product removal	- Ridge landfill site in Harwich Twp. - excellent potential for final disposal of solid product - existing waste disposal land use.	- experience in liquid industrial waste management - demonstrated process - can handle some organic content.
5. Woodington Systems, Inc.	9 months	$\$66-99/m^3$	Hearing plus solid product removal	- Walker Brothers Quarry, City of Niagara Falls - good potential for final disposal of solid product - existing waste disposal land use.	- experience in liquid industrial waste management - demonstrated process with good supporting technical data - can handle up to 5 percent organic content.
6. Tricil Waste Management Limited	6-9 months	not stated	Hearing costs only	- existing site of Tricil incinerator at Corunna - good potential for final solid residue disposal	- experience in liquid industrial waste management - undemonstrated technology - concern that air emission requirements may not be met.

company undertook to dispose of the solid product as directed by the Ministry. The Tricil proposal did not involve large quantities of solid product. The company has a disposal site suitable for the disposal of solid residues resulting from its proposed process. The other four proposals involve a potential cost to government for solid product relocation, if necessary. The hearing and related costs were considered by the Ministry to be comparable for all proposals. The potential for incurring solid product relocation costs was assessed in light of the potential suitability of the proposed sites for disposal of the solid product. The better the site, the less likelihood that relocation costs would be incurred.

With respect to site suitability, major difficulties were found with the sites proposed by Frontenac Chemical Waste Service Ltd., and Stablex (Canada) Ltd. The Ministry had some concerns about the hydrogeologic characteristics of the proposed Frontenac site adjacent to the Flamboro Steetley Quarry. These concerns raised questions about the suitability of the site for final product disposal. Also in the opinion of the Ministry's Regional Office, substantial public opposition to a facility at this site could be expected. The Stablex site also suffers from a lack of solid product disposal capability, and was considered to have only limited storage capability. There was also some uncertainty as to whether or not this site was even available, since the company had not obtained control of the site at the time of proposal evaluation.

The site proposed by Canadian Waste Technology Inc. on Commissioner Street in the City of Toronto is also somewhat disadvantaged by its lack of capability for final product disposal, making it necessary to find an alternative site if the solid product is found to be unusable in land reclamation, landfill or road construction operations.

With respect to the engineering and technical criteria, Canadian Waste Technology Inc. was the only company considered to be limited in experience of liquid industrial waste management. Also, the CWT proposal was deficient with respect to the quality control procedures considered necessary. The Ministry subsequently received a letter dated October 26, 1979 in which CWT withdrew its proposal, supporting instead the proposal by Frontenac.

Although Frontenac is experienced in the management of liquid industrial wastes, its operations in Hamilton have recently been criticized. Another difficulty with this proposal, is that it goes substantially beyond the terms of reference, including treatment of organic as well as inorganic wastes, and involving the consolidation of the company's existing oil and solvent recovery facilities into a long-term operation. Combined with the site disadvantages mentioned above, these factors resulted in a lower rating for this proposal than for those selected.

The proposal by Stablex (Canada) Ltd. was judged to be good from an engineering and technical standpoint, but because of the great uncertainty about the availability of

the site proposed by this company, and the site limitations mentioned above, it was not rated as high as the proposals by Browning Ferris Industries and Woodington Systems Inc. Both of the latter proposals combined a site having good potential for final product disposal with experience in liquid industrial waste management and a process demonstrated to be technically sound. For these reasons, the BFI and Woodington proposals were ranked highest.

The proposal put forward by Tricil Waste Management Ltd., a company experienced in the management of liquid industrial wastes, was not assessed favourably because it proposed an untried technology, and no pilot plant or process data were available. Although the proposed technology appears feasible on paper, there is some concern about whether air emission requirements of the Ministry could be met. For these reasons, this technology was judged more suitable for a small, pilot project.

On the basis of the foregoing evaluation, the proposals by Browning Ferris Industries and Woodington Systems Inc. were recommended for acceptance. The Ministry's senior management accepted these recommendations, and the two companies were advised that their proposals had been selected.

The Ministry has undertaken to operate an independent product and site evaluation program to accompany each of these projects in order to monitor the long-term stability of the solid product and the extent of leachate production. Details

of this evaluation program will be provided when available as an addendum to this report. Should environmental contamination problems develop at either site which cannot be mitigated by other means, the Ministry will relocate all solid product to a suitable location.

Following acceptance of their proposals, the companies retained consulting engineering firms who were commissioned to prepare that portion of the environmental assessment document which constitutes Volume II. In discussions between the consultants and the Ministry, it was agreed that the companies' environmental assessment documents should address, in detail, the description of the specific site and process being proposed, the construction, operation and abandonment phases of the project, the social and bio-physical environmental effects of each project phase on the surrounding communities and region, and proposed mitigating measures. The public information and community participation programs initiated by the companies at each site are also described in Volume II.

Selected References

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APPENDIX 1-A

Ontario

Ministry
of the
Environment

WASTE MANAGEMENT BRANCH
2ND FLOOR
135 ST. CLAIR AVE. W.
TORONTO ONTARIO
M4V 1P5 965-9670

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

September, 1979 (Summary Report)

Waste Classification	Volume (Gallons)
101 Acids	210,612
102 Alkalis	78,915
103 Metal Finishing Wastes	188,630
104 Cyanides	45
105 Chemical Fertilizer Wastes	20,500
106 Phosphates	19,525
190 Other (Inorganic)	567,974
201 Oily Water	1,279,420
202 Waste Oils	184,778
203 Organic Solvents	208,726
204 Chlorinated Solvents	2,365
205 Plastic Resins	53,724
206 Amines	7,650
207 Glycols	26,145
208 Phenols	24,788
209 PCB's	3,150
290 Other (Organic)	298,486
301 Pigments, Paint, Printing & Adhesives	240,960

... /2

Resource Recovery

September, 1979

302 Pesticides	12,250
303 Detergents, Cleaners & Soaps	30,600
304 Pharmaceutical & Cosmetics	--
401 Plant & Animal Wastes	295,431
402 Inert Sludges	674,020
Unspecified	34,175
GRAND TOTAL	4,462,869

Ontario

Ministry
of the
Environment

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

August, 1979 (Summary Report)

Waste Classification	Volume (Gallons)
101 Acids	257,581
102 Alkalis	171,415
103 Metal Finishing Wastes	217,065
104 Cyanides	6,630
105 Chemical Fertilizer Wastes	77,200
106 Phosphates	21,200
190 Other (Inorganic)	418,917
201 Oily Water	1,476,261
202 Waste Oils	160,902
203 Organic Solvents	344,620
204 Chlorinated Solvents	6,630
205 Plastic Resins	107,734
206 Amines	20,400
207 Glycols	33,675
208 Phenols	20,938
209 PCB's	--
290 Other (Organic)	305,858
301 Pigments, Paint, Printing & Adhesives	250,594

Resource Recovery

... /2

302 Pesticides	5,600
303 Detergents, Cleaners & Soaps	36,550
304 Pharmaceutical & Cosmetics	360
401 Plant & Animal Wastes	140,616
402 Inert Sludges	1,041,626
Unspecified	64,920
GRAND TOTAL	5,187,292

Ontario

Ministry of the Environment

WASTE MANAGEMENT BRANCH
2ND FLOOR
135 ST. CLAIR AVE. W.
TORONTO ONTARIO
M4V 1P5

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

July, 1979 (Summary Report)

Waste Classification	Volume (Gallons)
101 Acids	291,419
102 Alkalis	134,067
103 Metal Finishing Wastes	216,695
104 Cyanides	6,735
105 Chemical Fertilizer Wastes	40,200
106 Phosphates	29,500
190 Other (Inorganic)	588,877
201 Oily Water	1,444,133
202 Waste Oils	179,696
203 Organic Solvents	220,529
204 Chlorinated Solvents	3,145
205 Plastic Resins	69,770
206 Amines	13,850
207 Glycols	48,486
208 Phenols	38,347
209 PCB's	585
290 Other (Organic)	354,760
301 Pigments, Paint, Printing & Adhesives	251,548

... /2

Resource Recovery

302 Pesticides	7,800
303 Detergents, Cleaners & Soaps	50,759
304 Pharmaceutical & Cosmetics	2,502
401 Plant & Animal Wastes	176,183
402 Inert Sludges	1,144,648
Unspecified	45,915
GRAND TOTAL	5,360,149

Ontario

Ministry of the
Environment

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

June, 1979 (Summary Report)

Waste Classification	Volume (Gallons)
101 Acids	233,874
102 Alkalis	145,143
103 Metal Finishing Wastes	369,670
104 Cyanides	1,050
105 Chemical Fertilizer Wastes	113,500
106 Phosphates	10,000
190 Other (Inorganic)	445,458
201 Oily Water	1,098,517
202 Waste Oils	184,528
203 Organic Solvents	239,505
204 Chlorinated Solvents	9,650
205 Plastic Resins	109,400
206 Amines	15,300
207 Glycols	36,050
208 Phenols	54,790
209 PCB's	
290 Other (Organic)	332,185
301 Pigments, Paint, Printing & Adhesives	268,673

302 Pesticides	13,568
303 Detergents, Cleaners & Soaps	36,020
304 Pharmaceutical & Cosmetics	2,190
401 Plant & Animal Wastes	190,470
402 Inert Sludges	1,368,490
Unspecified	26,930
GRAND TOTAL	5,304,961

Ontario

Ministry of the Environment

WASTE MANAGEMENT BRANCH
2ND FLOOR
135 ST. CLAIR AVE. W.
TORONTO ONTARIO
M4V 1P5

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

May, 1979 (Summary Report)

Waste Classification	Volume (Gallons)
101 Acids	287,827
102 Alkalis	126,147
103 Metal Finishing Wastes	363,725
104 Cyanides	1,500
105 Chemical Fertilizer Wastes	11,200
106 Phosphates	7,800
190 Other (Inorganic)	648,451
201 Oily Water	1,484,627
202 Waste Oils	339,341
203 Organic Solvents	248,318
204 Chlorinated Solvents	3,300
205 Plastic Resins	88,570
206 Amines	18,300
207 Glycols	26,175
208 Phenols	71,856
209 PCB's	Nil
290 Other (Organic)	398,735
301 Pigments, Paint, Printing & Adhesives	361,846
302 Pesticides	13,260

Resource Recovery

303 Detergents, Cleaners & Soaps	26,100
304 Pharmaceutical & Cosmetics	3,022
401 Plant & Animal Wastes	180,653
402 Inert Sludges	1,467,719
Unspecified	55,215
GRAND TOTAL	6,233,687

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

(Summary Report) April, 1979

Waste Classification	Volume (gallons)
101 Acids	271,414
102 Alkalis	126,892
103 Metal Finishing Wastes	356,871
104 Cyanides	4,300
105 Chemical Fertilizer Wastes	28,600
106 Phosphates	34,700
190 Other (Inorganic)	698,226
201 Oily Water	1,014,498
202 Waste Oils	194,555
203 Organic Solvents	214,771
204 Chlorinated Solvents	13,530
205 Plastic Resins	97,560
206 Amines	33,320
207 Glycols	39,065
208 Phenols	45,220
209 PCB's	90
290 Other (Organic)	386,180
301 Pigments, Paint, Printing & Adhesives	298,261
302 Pesticides	39,630
303 Detergents, Cleaners & Soaps	34,570
304 Pharmaceutical & Cosmetics	3,855
401 Plant & Animal Wastes	182,981
402 Inert Sludges	1,159,193
Unspecified	127,738
GRAND TOTAL	5,406,020

Ministry of the Environment
Waste Management Branch
July, 1979

Ontario

Ministry of the Environment

WASTE MANAGEMENT BRANCH
2ND FLOOR
135 ST. CLAIR AVE. W.
TORONTO ONTARIO
M4V 1P5

QUANTITIES OF LIQUID INDUSTRIAL WASTES GENERATED

March, 1979 (Summary Report)

Waste Classification	Volume (Gallons)
101 Acids	439,784
102 Alkalis	138,309
103 Metal Finishing Wastes	352,385
104 Cyanides	1,040
105 Chemical Fertilizer Wastes	14,000
106 Phosphates	3,000
190 Other (Inorganic)	732,491
201 Oily Water	1,193,922
202 Waste Oils	223,918
203 Organic Solvents	253,148
204 Chlorinated Solvents	12,930
205 Plastic Resins	105,075
206 Amines	14,350
207 Glycols	33,950
208 Phenols	32,230
209 PCB's	6,000
290 Other (Organic)	291,884
301 Pigments, Paint, Printing & Adhesives	306,187

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Resource Recovery

302 Pesticides	39,850
303 Detergents, Cleaners & Soaps	39,500
304 Pharmaceutical & Cosmetics	4,383
401 Plant & Animal Wastes	191,350
402 Inert Sludges	771,962
Unspecified	91,493
GRAND TOTAL	5,293,141

APPENDIX 1-B

CLASSIFICATION GUIDELINE

FOR

HAULED LIQUID INDUSTRIAL WASTES

DECEMBER, 1978

Ontario
Ministry of the Environment

WASTE CLASSIFICATION GUIDE

CLASS NO.	WASTE DESCRIPTION
101	ACIDS
	Sulfuric Acid
	Hydrochloric Acid
	Pickling Acid
	Pickle Liquor
	Stripping Solution
	Sulphonation Waste
	Low pH Waste
	Carbonate Waste
	Aluminum Chloride
	Acid Sludge
	Sulphate Sludge
	Acetic Acid
	Formic Acid
	Fatty Acids
	Phosphoric Acid
	Nitric Acid
102	ALKALIS
	Caustic Solution
	Lye
	Soda
	Sodium Hydroxide
	Metal Cleaners
	Potash
	Ammonia
	Hydration Filtrate
	Bleaching Powder
	Aluminum Hydroxide
	Xanthelene (Alkali & Sulfur)
	Aluminux
	Lime Sludge
	Caustic Sludge
103	METAL FINISHING WASTES
	Lead Chromate
	Zinc Chromate
	Chromic Acid
	Sodium Chromate
	Potassium Dichromate
	Chromium Sulphate
	Chromium Hydroxide
	Chromium Dioxide
	Chromium Sludge
	Zinc Plating Solution
	Zinc Hydroxide
	Zinc Sulphate
	Zinc Sludge
	Flux
	Nickel Plating Solution
	Nickel Sludge
	Brass Plating Solution
	Brass Pickle Acid
	Copper Plating Solution
104	CYANIDES
	Sodium Cyanide
	Scrap Cyanide
	Stretford Liquor
	Cyanide Sludge
105	CHEMICAL FERTILIZER WASTES
106	PHOSPHATES
	Bonderite
	Phosphate Sludge
	Phosphate Slurry

CLASS NO.	WASTE DESCRIPTION
201	OILY WATER
	Oil and Water
	Diesel Fuel and Water
	Gasoline and Water
	Tanker Washings
	Spine Finish Waste
	Interceptor/Separator Waste
	Oil and VARSOL
	Coolants
	Slop Oil
	Tank Sludge
	Oil, Sand & Water
	Skimming Sludge
	Tar and Water
	Oily Sludge
	Pit Sludge
202	WASTE OILS
	Used Oil
	Bunker Oil
	Crude Oil
	Kerosene
	Naphtha & Gas
	Asphalt
	Tars
203	ORGANIC SOLVENTS
	Acetone
	Methyl Ethyl Ketone (MEK)
	Alcohols
	Thinner
	Methyl Hydrate
	Ketones
	Fomaldehyde
	Cyclohexane
	Isopropyl Alcohol (IPA)
	Hexane
	Enamel Laquers
	Benzene
	Toluene
	Xylene
	Aromatic Hydrocarbons
	Styrene
	DOWTHERM
	Ethyl Benzene
	VARSOL
	Hexalene

CLASS NO.	WASTE DESCRIPTION
204	CHLORINATED SOLVENTS
	Carbon Tetrachloride (CCl_4)
	Trichloroethylene
	Perchloroethylene
	Dry Cleaner's Solutions
205	PLASTIC RESINS
	Vinyl
	Acrylic Resin
	Plasticizers
	Polymerstyrene
	Polyethylene
	Polystyrene
	Acrylonitrile (ACN)
	Nylon Salt Solution
	Malic Anhydride
	Styrene Acrylonitrile (ABS)
	Methyl Methacrylate
	Varnish
	Polyvinyl Chloride (PVC)
	Latex
	Isoprene
206	AMINES
	Amide
	Toluene Diamine (DA)
	Trimethylamine (TMA)
	Triethylamine
	Urea
	Alcanolamines
	Oxazolidone
	MEA
	DEA
	FLEXONE
	MONEX
207	GLYCOLS
	Polyether Glycol
	Propylene Glycol
	Polyglycol
	Polypropelene Glycol (VORANOL)
	Antifreeze
	DR-I Wash

CLASS NO.	WASTE DESCRIPTION
208	PHENOLS
	TDI Residue
	Phenolic Oil
	Phenol and Water
209	PCB's
	PCB Liquid
	ASKAREL
	INERTEEN
	PYRDRAUL
301	PIGMENTS, PAINTS, PRINTING & ADHESIVES
	Dye Solution
	Paint Solution
	Waste Ink
	Paint Sludge
	Wax and Water
	Rubber Cement
	Pigment Sludge/Slurry
302	PESTICICES
	Pesticide Solutions
	VITAVAX
303	DETERGENTS, CLEANERS & SOAP
	Laundry Wastes
304	PHARMACEUTICAL & COSMETICS
*190	OTHER INORGANIC (to be stated)
*290	ORTHER ORGANIC (to be stated)

CLASS NO.	WASTE DESCRIPTION
401	PLANT AND ANIMAL WASTES
	Fat and Water
	Lignin
	Glue Wastes
	Grease and Water
	Molasses
	Tallow
	Concentrated Flavours
	Bacterial Sludge
	Grain and Water
	Mash
	Protenaceous Sludge
	Food Wastes
	Vegetable Oils
	Tannery Wastes
402	INERT SLUDGES
	Portland Cement
	Concrete Slurry
	Glazing Slurry
	Marble Sludge
	River Silt
	Carbon Black
	Metal Fines
	Clay Slurry
	Scrubber Water
	Scale
	Sand and Water
	Rock Wool
	Filter Backwash
	Silica
	Starch
	Titanium
	Plaster of Paris (Gypsum)
	Metalic Hydroxide Sludges (excluding chromium)

*These are wastes not otherwise classified. If a particular waste description recurs a significant number of times, it will be included separately on the next printing of the guide.

APPENDIX 1-C

INSTRUCTIONS

1. WHEN A LOAD IS PICKED UP FROM THE SOURCE:

   (a) THE CARRIER shall complete SECTION C, and an authorized person at the SOURCE shall complete SECTION A. The **White** and **Green** Copies are then left with the SOURCE.

   (b) THE SOURCE shall mail the **White** copy to the Ministry of the Environment at the address shown below, and retain the **Green** copy for one year.

---

2. WHEN A LOAD IS DELIVERED TO THE RECEIVER:

   (a) THE RECEIVER shall complete SECTION B. The **Yellow** and **Blue** copies are left with the RECEIVER. THE CARRIER may retain the **Pink** copy for his records.

   (b) THE RECEIVER shall send the **Yellow** copy to the Ministry of the Environment at the address shown below, and retain the **Blue** copy for one year.

---

3. WHEN A LOAD IS DELIVERED TO A SEWAGE WORKS:

   THE CARRIER shall complete SECTION B and mail the **Yellow** copy to the Ministry of the Environment at the address shown below. THE CARRIER shall retain the **Blue** copy for one year.

---

4. MAIL THE MINISTRY'S COPIES BY THE LAST DAY OF EACH WEEK,

   TO: The Ontario Ministry of the Environment
   Waste Management Branch
   135 St. Clair Avenue West
   Toronto, Ontario
   M4V 1P5

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5. **** PENALTY ****

The maximum penalty for conviction on failing to comply with the regulation is $2,000. (Environmental Protection Act, 1971, Section 47)

Ministry of the Environment
Ontario

Transfers of Liquid Industrial Waste

Ontario Regulation 926/76

Important: See Instructions on Reverse

SOURCE (Complete Section A Only. Please Print)

A

Company Name

Waste Source Location — City/Town

Waste Description: Check One.

101 ☐ Acids
102 ☐ Alkalis
103 ☐ Metal Finishing Wastes
104 ☐ Cyanides
105 ☐ Chemical Fertilizer Wastes
106 ☐ Phosphates

201 ☐ Oily Water
202 ☐ Waste Oils
203 ☐ Organic Solvents
204 ☐ Chlorinated Solvents
205 ☐ Plastic Resins
206 ☐ Amines
207 ☐ Glycols
208 ☐ Phenols
209 ☐ PCB'S

301 ☐ Pigments, Paint, Printing & Adhesives
302 ☐ Pesticides
303 ☐ Detergents, Cleaners & Soaps
304 ☐ Pharmaceutical & Cosmetics
401 ☐ Plant & Animal Wastes
402 ☐ Inert Sludges

190 ☐ Other Inorganic _____ (Specify)

290 ☐ Other Organic _____ (Specify)

Quantity ☐ Gallons ☐ Litres

Time Released | Day | Month | Year | Signature of Authorized Person

RECEIVER (Complete Section B Only. Please Print)

B

Company Name — MOE Certificate of Approval No. A

Site Location — City/Town

Transfer To: ☐ _____

DO NOT WRITE IN THIS AREA

By: ☐ Other (State Method) _____

Time Received | Day | Month | Year | Signature of Authorized Person

CARRIER (Complete Section C Only. Please Print)

C

Company Name — Waste Mgmt System Number A

Address — Number — Street — City/Town

Vehicle License Plate Number

Signature of Driver

MOE 1270 (8/78)

THE ENVIRONMENTAL PROTECTION ACT, 1971

O. Reg. 926/76.
Transfers of Liquid Industrial Waste.
Made—November 10th, 1976.
Filed—November 18th, 1976.

REGULATION MADE UNDER THE ENVIRONMENTAL PROTECTION ACT, 1971

TRANSFERS OF LIQUID INDUSTRIAL WASTE

1.—(1) In this Regulation,

(*a*) "hauler of waste" means a person who transports liquid industrial waste;

(*b*) "liquid industrial waste" means liquid waste that is a product of,

(i) an enterprise or activity involving industrial, manufacturing or commercial processes or operations,

(ii) research or an experimental enterprise or activity, or

(iii) an enterprise or activity to which subclause i would apply if the enterprise or activity were carried on for profit,

but does not include,

(iv) waste that is a product of a sewage system subject to the provisions of Part VII of the Act or a sewage works subject to *The Ontario Water Resources Act* or waste that is removed from a holding tank to which regulations made under clause *a* or *b* of subsection 3 of section 94 of the Act apply,

(v) waste discharged by its producer at the site where the waste is produced into municipal sanitary sewage works in accordance with applicable by-laws or into a sewage system, as defined in Part VII of the Act, that is being operated in accordance with the Act,

(vi) waste disposed of at a waste disposal site as defined in Part V of the Act, operated by the producer of the waste and located on the site where the waste is produced, or

(vii) waste that is wholly used or recycled

(2) Liquid industrial waste is designated as a waste in addition to those wastes specified in clause *d* of section 28 of the Act. O. Reg. 926/76, s. 1.

2. Those facilities, equipment and operations of a producer of liquid industrial waste that are involved in the collection, handling or storage of liquid industrial waste are classified as a Class 1 waste management system. O. Reg. 926/76, s. 2.

3. Those facilities, equipment and operations of a hauler of waste that are involved in transporting liquid industrial waste are classified as a Class 2 waste management system. O. Reg. 926/76, s. 3.

4.—(1) No operator of a Class 1 waste management system shall permit liquid industrial waste to pass from his control except by transfer of the liquid industrial waste to a Class 2 waste management system for which a certificate of approval or a provisional certificate of approval has been issued.

(2) Where liquid industrial waste is transferred to a Class 2 waste management system from a Class 1 waste management system,

(*a*) the operator of the Class 2 waste management system shall provide to the operator of the Class 1 waste management system a numbered form obtained from the Ministry for the purpose, upon which form he has recorded his name and address and the registration number of the vehicle used; and

(*b*) the operator of the Class 1 waste management system shall obtain from the operator of the Class 2 waste management system the form referred to in clause *a* and shall,

(i) record on the form,

a. the name and address of the producer of the liquid industrial waste,

b. the description and amount of the liquid industrial waste being transferred, and

c. the date, time and place of the transfer,

(ii) sign the form, and

(iii) forward the completed form forthwith to the Ministry, retaining one copy thereof for a period of one year. O. Reg. 926/76, s. 4.

5.—(1) No operator of a Class 2 waste management system shall permit liquid industrial waste to pass from his control except by transfer of the liquid industrial waste,

(*a*) to a waste management system or a waste disposal site for which a certificate of approval or a provisional certificate of approval has been issued; or

(*b*) to a sewage works under *The Ontario Water Resources Act* for which an approval under that Act has been issued and with the approval of the owner of such sewage works.

(2) Where liquid industrial waste is transferred from a Class 2 waste management system,

(*a*) the operator of the Class 2 waste management system shall,

(i) on a numbered form obtained from the Ministry for the purpose, record,

a. his name and address,

b. the registration number of the vehicle used,

c. a list of the numbers of all the forms provided pursuant to clause *a* of subsection 2 of section 4 in respect of the liquid industrial waste being transferred, and

d. if any of the liquid industrial waste being transferred was received from a Class 2 waste management system, a list of the numbers of all forms with which he was provided in respect of the receipt of the liquid industrial waste being transferred, and

(ii) if the transfer is to a sewage works under *The Ontario Water Resources Act*,

a. record on the same form,

1. the location of the sewage works,

2. the description and amount of the liquid industrial waste being transferred, and

3. the date, time and place of the transfer, and

b. sign the form and forward the completed form forthwith to the Ministry, retaining one copy thereof for a period of one year, or

(iii) if the transfer is to a waste management system or waste disposal site, provide the operator thereof with the form prepared as prescribed in subclause i of clause *a*; and

(*b*) the operator of a waste management system or waste disposal site to which the liquid industrial waste is transferred shall obtain the form prepared as prescribed in subclause i of clause *a* and shall,

(i) record on the form,

a. the location and the name of the operator of the waste management system or waste disposal site,

b. the number of the certificate of approval or provisional certificate of approval for the waste management system or waste disposal site,

c. the description and amount of the liquid industrial waste being transferred,

d. the date, time and place of the transfer of the liquid industrial waste, and

e. the date and method of disposal, the method of treatment or processing, or the destination of the liquid industrial waste, whichever is applicable,

(ii) sign the form, and

(iii) forward the completed form forthwith to the Ministry, retaining one copy thereof for a period of one year. O. Reg. 926/76, s. 5.

6.—(1) A Class 1 waste management system is exempt from section 31 of the Act in respect of the collection, handling and temporary storage of liquid industrial waste at the site where it is produced.

(2) The exemption in subsection 1 does not apply where the liquid industrial waste is a product of a waste management system or waste disposal site. O. Reg. 926/76, s. 6.

7. This Regulation comes into force on the 1st day of April, 1977. O. Reg. 926/76, s. 7.

APPENDIX 1-D

List of Sites Accepting Liquid Industrial Wastes - May 1979

A. Sites Properly Certified

1. City of Hamilton, Upper Ottawa Street Landfill
   Certificate No. A130103

2. City of Brantford
   Certificate No. A100101

3. Town of Paris
   Certificate No. A100201

4. Town of Arnprior, Township of McNab, Lot.10 Conc.3
   Certificate No. A412603

5. City of Cornwall, Cornwall Industrial Landfill
   Certificate No. A480101

6. City of Barrie, Sandy Hollow Site
   Certificate No. A250101

7. Eric Pauze Construction Ltd., Twp. of Tiny
   Certificate No. A253101

8. Township of Hamilton, Baltimore Landfill Site
   Certificate No. A311801

9. Ridge Landfill Corp. Ltd., Harwich Twp.
   Certificate No. A021601

10. City of Stratford
    Certificate No. A150101

11. Tricil Waste Management Ltd., Moore Twp.
    Certificate No. A031806

B. Sites Restricted to Oily Waters for Dust Control

1. Crawford Sand & Gravel, Vaughan Twp.
   Not Certified

2. Gormley Sand and Gravel, Gormley Ontario
   Not Certified

C. Transfer Stations

1. Howard Campbell & Sons, Twp. of Elizabethtown
   Certificate No. A441504

2. O.E. MacDougall Liquid Waste Service & Systems Ltd., Twp. of Elizabethtown
   Certificate No. A441503

D. Sites Scheduled to Close by December 31, 1979

1. Township of Nepean
   Certificate No. A461301

2. Industrial Disposal Co. (Oshawa)
   Certificate No. A390102

E. Sites Not Certified to Receive Liquid Industrial Wastes

1. Guelph Landfill Site
   Certificate No. A170101

2. Township of McNab Municipal Landfill, McNab Township, Lot 18, Conc. 6
   Certificate No. A412605

3. Twp. of Alice & Fraser Municipal Landfill
   Certificate No. A411601

4. Town of Perth Municipal Landfill, Twp. of North Emsley
   Certificate No. A451202

5. Howard E. Rump Landfill, Twp. of West Carleton
   Certificate No. A461002

6. York Sanitation Co. Ltd., Aurora
   Certificate No. A230201

APPENDIX 1-E

Ontario

Ministry
of the
Environment

4375 Chesswood Drive
Toronto, Ontario M3J 2C2
(416) 636-8015

July 3, 1979

REGISTERED MAIL

Re: Request for Proposal -
Limited-Term Solidification
Facilities for Liquid Industrial
Wastes in Ontario

The attached "Request for Proposal" details the needs for limited-term facilities to treat and dispose of liquid industrial wastes in Ontario and indicates that the best limited-term solution to the problem at this time is the establishment of one or two "silicate-based" chemical fixation or solidification plants.

Your company has been invited to submit a proposal because the Ministry is aware that either your company markets a potential waste solidification process or that your company is established in the waste treatment and disposal field and may have access to a solidification process. A list of other companies invited to submit proposals is attached for your information. The Ministry also intends to advertise through appropriate media.

Also attached for your information is a waste classification guideline. The 20-25 million gallons referred to in the Request for Proposal is made up primarily of categories in the 100 series and categories 201, 301, 303, 402 and 190. Wastes which can be incinerated should not be considered for solidification.

..../2

Resource Recovery

If your company is interested in submitting a proposal, more detailed information on the types and quantities of wastes can be made available upon request.

As stated in the Request for Proposal, any proposal to establish facilities will be subjected to an environmental hearing under the terms of The Environmental Assessment Act, 1975. A copy of this Act is attached also for your information. The Ministry is prepared to assist the successful proponent(s) through the hearing process and staff will be available to help in the preparation of the submission to the Hearing Board.

Would you please acknowledge receipt of this request at your earliest convenience and indicate whether your company is interested in submitting a proposal.

Yours truly,

L. F. Pitura, Director
Waste Management Branch

/nlc

Attachments

cc E. W. Turner

MINISTRY OF THE ENVIRONMENT

REQUEST FOR PROPOSAL TO ESTABLISH FACILITIES FOR THE CHEMICAL FIXATION OR SOLIDIFICATION OF LIQUID INDUSTRIAL WASTES IN ONTARIO

1. BACKGROUND INFORMATION

In October, 1978, the Minister of the Environment, the Honourable Harry Parrott, DDS, announced his intention to ban the direct landfilling of untreated liquid industrial wastes in Ontario after January 1, 1980.

Following the announcement, Ministry staff have talked to companies in the waste management business about the prospects for developing alternative waste treatment and disposal facilities in the Province but, to date, no proposals have been received which could provide alternative outlets in a reasonable timeframe.

On January 1, 1980, generators of waste will be faced with the prospect of having no place in Ontario to dispose of a large quantity of wastes currently going to landfills. With this in mind, the Ministry reviewed a number of alternative waste treatment and disposal technologies and concluded that silicate-based, chemical fixation or solidification offers the best prospects for developing limited-term, (non-permanent), disposal facilities. Chemical fixation or solidification, it was reasoned, would be able to handle the bulk of the 20-25 million gallons per year of wastes which are not incinerated and which are currently landfilled or exported to the United States. Meanwhile, the Ministry is proceeding with its long-term plan to develop permanent treatment and disposal facilities in the Province. Solidification will be considered also in the long-term plan.

2. DETAILS OF PROPOSAL

a) Concept

The concept being proposed is the establishment of one or two, limited-term, solidification plants which would handle a wide variety of wastes, convert these into a "solid" material

which could be stockpiled under controlled conditions until such time as permanent treatment and disposal facilities are available.

Surface run-off and leachate from the stockpile could be collected and re-treated. Also, the plants would provide a solidified product which could be used to assess the process. Final disposition of the stockpiled material would be largely dependant on the data collected from such an assessment program.

The Ministry estimates that one or more plants would be required for a limited-term, up to five years. This time-frame is based on an estimate of the time required to develop permanent facilities consistent with the Ministry's long-term plan. A solidification plant may be converted into a permanent facility, providing its acceptability if proven and providing it can be made to fit into the overall Provincial scheme for waste handling.

b) Sites

(i) Ownership: The Ministry is seeking proposals for the development of facilities on privately-owned sites.

(ii) Number of Plants: To minimize the impact of transportation costs on the waste generators, the Ministry believes that at least two plants may be required.

(iii) Plant Locations: Plants should be located bearing in mind that the following general areas represent major concentrations of waste producing industries:

- Toronto-Hamilton area;
- Sarnia-Windsor area.

(iv) Siting: Due to the limited term of these solidification facilities and the potential environmental concerns, sites which may not meet long-term disposal requirements can be considered.

Should a site be proposed as a permanent site with on-site, permanent disposal of the solidified product, the Ministry may wish to enter into an agreement with the site owners whereby the Crown acquires the disposal site and its liabilities.

(v) Zoning: Local zoning requirements will have to be considered. The Ministry is prepared to assist where problems are encountered.

c) Government Involvement

(i) Costs Associated with Environmental Hearings: An environmental hearing, pursuant to the requirements of The Environmental Assessment Act, will be required for each site proposed.

The government is prepared to underwrite the costs of a hearing in the event that approval is not granted up to a maximum amount of $100,000 for each site.

Where approval is granted, the proponent will be expected to recover the cost of the hearing as part of the fee structure.

(ii) Costs Associated with Removal of Solidified Material: The cost of moving accumulated solidified material to a permanent disposal site at the end of the term, if necessary, should not be allowed for in this proposal since the government will undertake this responsibility.

(iii) Viability of Plant(s): On January 1, 1980, landfilling of untreated liquid industrial wastes will be prohibited by regulation and strictly enforced. The impact of the regulation forms the guarantee that generators and haulers of liquid industrial wastes will have to use the facility. Flow of wastes to approved private facilities may also occur over time and be competitive with the solidification plant.

The proponent should take the factor of regulatory impact into account in the development of a financial forecast for a plant operating for a limited period of five years. Consideration should be given to the influence of other facilities including a second solidification plant as well.

Within this context, the proposal should elaborate on any additional requirements necessary to ensure a viable enterprise. These requirements will be taken into account on assessing the proposals.

(iv) Bonds: The government will expect the successful proponent(s) to offer a performance bond on its process to ensure that the process will, in fact, meet all its claims. The amount of the bond expected would be in the order of 50 percent of the capital cost of the project, excluding land costs.

d) Financial Considerations

(i) Detailed Cost Estimate: As part of the proposal, the proponent should submit a detailed breakdown of estimated costs. This breakdown should include:
- cost of land;
- capital cost of plant;
- capital cost of site development;
- engineering and consultants fees;
- environmental hearing costs.

(ii) Fees: To enable the Ministry to assess alternative proposals, the proponent should submit as part of any proposal, a schedule of fees. This schedule should include projected fees for various levels of operation, eg., 5, 10, 15 or 20 million gallons per year.

e) Solidification or Chemical Fixation Process

(i) General: The proposal should include details of the proposed process, including any patent descriptions, assessment reports, laboratory data, etc., pertinent to the application of the process to mixed liquid industrial wastes.

(ii) Other Applications: The proposal should document application of the process in other fields or countries which may be pertinent to an assessment of the process.

(iii) Quality Control: The proposal should provide details of a corporate approach to quality control, with respect to the receipt, storage and processing of wastes. Proposed controls on the disposition of the processed materials should also be furnished.

(iv) Leachate Collection and Monitoring: The proposal should provide sufficient detail to describe how the surface run-off and leachate from the stockpiled material will be collected and treated. Also, any special monitoring requirements necessary to ensure "safe" storage should be discussed.

(v) References/Contacts: The proponent should furnish names and addresses of references and contacts which the Ministry could use in assessing the proponent and the process.

f) Experience/Staffing

The proponent should submit documentation of the company's experience in the waste treatment field, together with details of the background and experience of corporate staff members who would be assigned responsibilities for this project.

g) Timetable

The proponent should provide a timetable for the project which will include the following:

(i) preparation for environmental hearing including site assessment, engineering and preparation of assessment statement;

(ii) following approval, site preparation and plant construction time schedules.

h) Contract/Agreement

The proponent should provide details of any special terms and conditions which will be required from a corporate standpoint before a contract or agreement can be finalized.

3. GENERAL

The Ministry is attempting to solicit the assistance of the waste disposal industry by forwarding this request for proposals to a number of companies known to own or have rights to solidification processes. A list of those receiving this request is attached for your information.

a) Proposal Deadline

A proposal, developed on the basis of the above requirements, should be forwarded to the Ministry no later than August 15, 1979, addressed to:

Mr. L. F. Pitura, Director
Ontario Ministry of the Environment
Waste Management Branch
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5

b) Enquiries on Proposal

Any enquiries on this request for proposals should be made directly to:

1. Mr. E. W. Turner
   Tel: (416)636-3284 or 636-5329

2. Mr. L. F. Pitura
   Tel: (416)636-3284 or 636-8015

If necessary, staff will be willing to meet with proponents at their convenience prior to the submission of a proposal.

c) Interviews

Following the receipt of proposals, as an aid to assessing the various companies before a decision is made, the Ministry may wish to interview those companies which submit proposals.

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LIST OF COMPANIES RECEIVING RFPs DATED JULY 3, 1979

1. Mr. Steven R. Siegel
   Director of Corporate Development
   SCA Services, Inc.
   99 High Street
   Boston, Massachusetts 02110
   (617)423-4100

2. Mr. J. G. Temple
   District Manager
   Canadian Waste Management
   55 Fenmar Drive
   Weston, Ontario
   M9L 1M4
   (416)741-1600

3. Mr. John Layman, Director
   Market Development - Canada
   Browning-Ferris Industries
   161 Bridgeland Avenue
   Toronto, Ontario
   M6A 1Z1
   (416)789-7341

4. Mr. Ross R. Clarkson, Manager
   Woodington Systems, Inc.
   c/o Walker Brothers Quarries Limited
   P.O. Box 100
   Thorold, Ontario
   L2V 3Y8
   (416)262-4414 (Woodington) or (416)227-4142 (Walkers)

5. Mr. R. H. Smith
   Stabatrol Corporation
   1000 Conshohocken Road
   P.O. Box 578
   Norristown, Pennsylvania 19404
   (215)825-2675

6. Mr. D. Krofchak, President
   Canadian Waste Technology, Inc.
   160 Torbay Road
   Markham, Ontario
   L3R 1G6
   (416)495-9502

7. Mr. John T. Schofield, President
   STABLEX Corporation
   Two Radnor Corporate Centre
   Suite 110
   Radnor, Pennsylvania 19087
   (215)688-3131

8. Mr. George Lodick, Jr.
President
Frontenac Chemical Waste Service
1960 Brampton Street
Hamilton, Ontario
(416)545-4406

9. Mr. Robert F. Skoog
Industrial Sales Manager
IU Conversion Systems, Inc.
115 Gibraltar Road
Horsham, Pennsylvania 19044

(215)441-5900

10. Mr. Richard Day, President
Tricil Limited
101 Queensway West
Suite 400
Mississauga, Ontario
L5B 2P7
(416)270-8280

11. Mr. Serge Rysman De Lockerente
Docteur En Sciences
Cemstobel, S.A.
Rue Du Canal 59
1000 Bruxelles
Belgium

cc Mr. Charles A. Chantraine
Trade Commissioner
Consulate General of Belgium
8 King Street East
Suite 1901
Toronto, Ontario
M5C 1B5
(416)364-6546

12. Copy of letter sent to:

Mr. Richard L. Hanneman
Director of Public Affairs
National Solid Wastes Management Association
1120 Connecticut Avenue, N.W. - Suite 930
Washington, D.C. 20036
(202)659-4613

LIST OF COMPANIES RECEIVING RFPs UPON REQUEST TO WASTE MANAGEMENT BRANCH

1. Mr. Ciepiela
   Francis Hankin and Company Limited
   117 Crockford Blvd
   Scarborough, Ontario
   M1R 3B9

2. Mr. T. W. Drew
   Chemical Waste Management Limited
   Spring Creek Road and Thompson Avenue
   P.O. Box 372
   Smithville, Ontario
   L0R 2A0

3. Mr. Jerry Rupke
   Rupke and Associates Limited
   R. R. #4
   Bradford, Ontario

4. W. A. Vanderland
   Rothsay Concentrates Company Limited
   R. R. #1
   Moorefield, Ontario
   N0G 2K0

5. Mr. Eric Sanderson
   SNC-GECO
   74 Victoria Street
   Toronto, Ontario
   M5L 2A5

6. James Artt Contracting Limited
   Mr. James M. Artt
   Mr. Patrick Mattews
   Burlington, Ontario
   L7L 3T4

7. Mr. H. T. Marentette
   M. B. L. International Contractors Inc
   5345 E. C. Row Avenue
   P.O. Box 1120
   Windsor, Ontario
   N9A 6P9

8. Mr. R. E. Irwin
   Industrial Hydrocarbons Limited
   Pilot Plant and Laboratory
   1312 Speers Road
   P.O. Box 908
   Oakville, Ontario
   L6L 2X4